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FACTORS INFLUENCING CONTROL OF COLOR IN AMBER GLASSES

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Introduction

Controlling color of amber container glass during production usually presents no major problem. The industry has always had fairly wide limits in which to work and the individual plants have their own individual systems for controlling color. The individual systems of controlling intensity of amber color are as many and as varied as the colorants used to produce the amber glasses. It is indeed rather amazing to find what a great range of different materials are used to produce the so-called carbon-sulfur amber glasses. It is even more amazing to discover that, with this wide variety of approaches to development of amber color, in the final result practically all produce satisfactory amber container glass. Some systems are no doubt better than others; internal control over oxidation-reduction necessary within the batch itself will go a long way towards overcoming some of the natural variables encountered in the glass melting process.

It is the intent of this article to present a review of the known factors influencing variation in amber color intensity and every attempt will be made to keep the discussion on a practical plane. In recent years the subject of holding closer limits on amber color has been receiving more emphasis in the eyes of the consumer. Each of the major users of amber container ware has a slightly different idea as to just what it is he wants. The result has been to impose in some cases a very difficult problem of making amber containers light enough to please one customer, yet dark enough to keep another happy on the same furnace on the same day. In short it would seem that variations in amber color are becoming much more important than they have been in the past. Graph 1 illustrates the variation existing in amber color. Data is plotted as per cent transmission measured at 550 Mμ versus yellowing factor, and represents 30 different amber glasses. As can be seen, the spread in color is quite wide. If strict specifications are applied, then only a relatively few meet all specifications on color.

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What Produces the Amber Color?

It is not our intention to review all of the extensive literature available on this subject. The subject is very fascinating, particularly from a practical viewpoint, because quite often color variations coincide with other troubles such as unstable glass and blisters.

Cole[1] attributes the amber color to ferrous polysulphide groupings in the glass structure stating that, as the length of the sulfur chain increases, the instability of the glass also increases. Cole also states that brownish tints are due to excess reduced iron, and that greenish tints are due to excess oxidized iron, facts which are borne out pretty well in practical plant usage in color control.

Neumann, Dietzel[2] state that there are two color groups involved, namely Na_2S_2 and FeS_2. These groups setting up an equilibrium as follows,

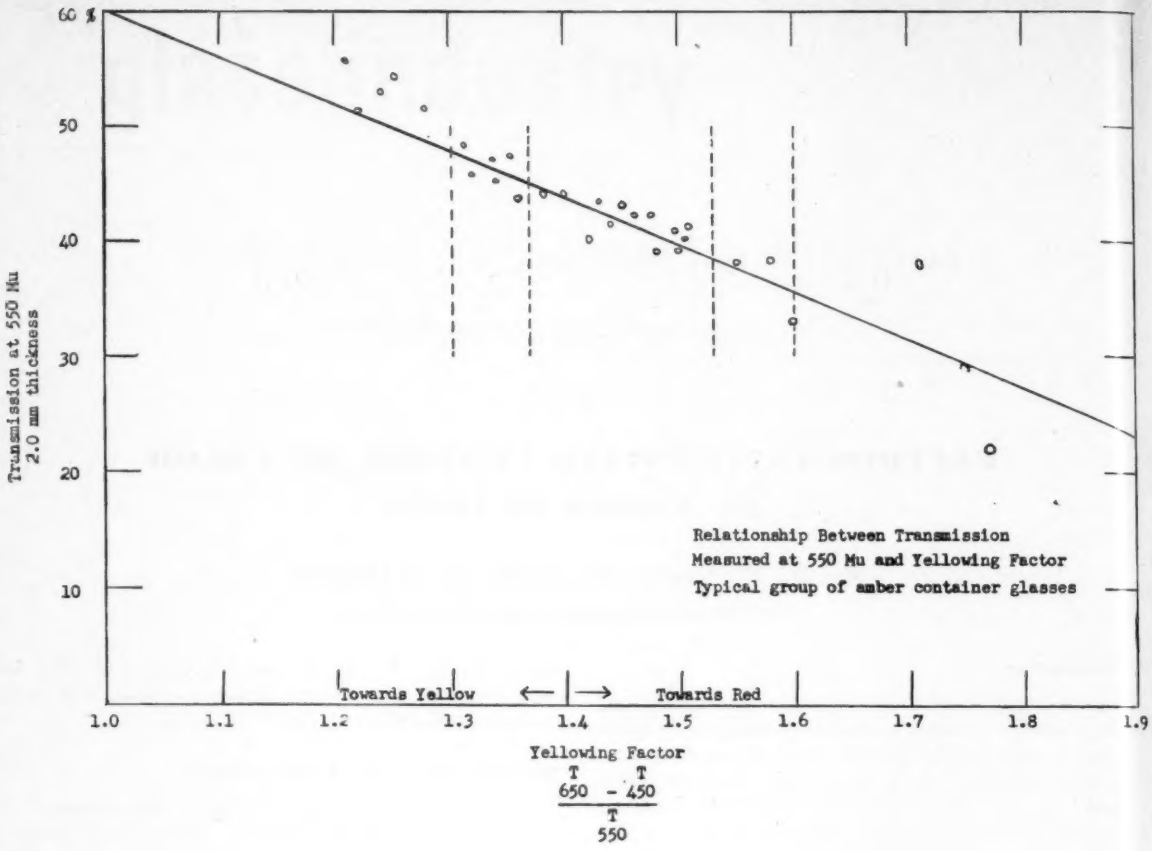
$$2\ FeS + Na_2S_2 \rightleftarrows 2\ NaFeS_2$$

iron sulphide being the brown component with the sodium polysulphide contributing the reddish tint; formation of the polysulphide group depending upon relatively low iron values but iron always being a part of the color group.[3]

Other theories on what actually produces the amber color group exist besides the two given here. Bacon and Spix,[4] in their study of the effect of heat treatment on amber bottle glass, have made some very interesting comment on how their data fits into the color groups given. Lyle[5] has discussed the influence of base composition and minor constituents.

It is not our intent to go into the influence of base composition since from the practical point of view a glass company producing amber container ware is always striv-

GRAPH 1.



ing for a constant given composition and working viscosity. It is our desire to highlight the influence of oxidation-reduction influences as they effect variations in resulting amber color, these main influences having their origins in furnace firing and internal balance of any given glass batch producing any definite glass composition.

Discussion of Main Causes of Amber Color Variations

TABLE I.

Color Darkeners Reducing	*Color Destroyers or Modifiers -Oxidizing*
Carbon	Oxidizing furnace atmosphere
Sulfur	Any oxidizing agent in the batch such as Na_2SO_4, $CaSO_4$, $BaSO_4$, $NaNO_3$, etc.
Iron (Fe) (FeO) (Fe_2O_3) (Fe_3O_4)	
Fluorspar (CaF_2)	
Manganese (MnO_2 or MnO)	Water on batch or water of hydration
High Furnace Pull	FeO, Fe_2O_3, Fe_3O_4
Purchased cullet	Low furnace pull
Annealing	Clean wet plant cullet
Ni, Cr, Cu, Pb	Annealing

Above is a table showing color intensifiers and color destroyers or modifiers. Points of necessity overlap due to the fact that color variation is fundamentally an oxidation-reduction reaction. Amber color simplified seems to be essentially the following reaction:

$$2\,FeS + 3\,O_2 \rightarrow 2\,FeO + 2\,SO_2 \uparrow$$

If there is not enough iron present to form FeS groupings, then the group $NaFeS_2$ is the color group being oxidized or reduced. With this background, we will discuss the individual causes of color variation in more detail.

a. Color Darkeners

(1) Carbon. The function of carbon in any amber glass batch is almost solely to prevent the oxidation of sulfur and to allow the formation of the FeS or $NaFeS_2$ groups producing the color. All agree that carbon or other reducing agents do not contribute to the color forming groups; it simply sets up the reducing condition necessary. Carbon actually does two things: it insures presence of divalent iron and prevents oxidation of sulfur. Variations in amount of carbon present, whether it be added as powdered coal in the batch or as plain dirt in unwashed cullet, will cause marked variations in amber color. Due to its greater affinity for oxygen, one pound of carbon will have much more influence than one pound of sulfur.

Presence of sulfur as such is not necessary in an amber batch if sufficient carbon is used in conjunction with a sulfate. Reaction is as follows:

$$Na_2SO_4 + 2C \rightarrow Na_2S + 2\,CO_2 \uparrow$$

(2) Sulfur. According to K. Fuwa,[6] sulfur influences color of carbon-sulfur ambers as follows:

TABLE II.

%S added to batch	%S found in glass	Color of glass	% Sulfur retained in glass
0.2	0.0048	bluish	2.4
0.4	0.0056	bluish	1.4
0.6	0.0080	greenish	1.3
0.8	0.0230	orange-yellow	2.9
1.0	0.0650	orange	6.5
2.0	0.18	dark orange	9.0
3.0	0.34	dark orange	11.3
4.0	0.46	brown	11.5

This table illustrates quite markedly how easy it is to oxidize sulfur. Fuwa's work would indicate that about 90% of all sulfur is oxidized and therefore has no chance to enter into the color forming groups.

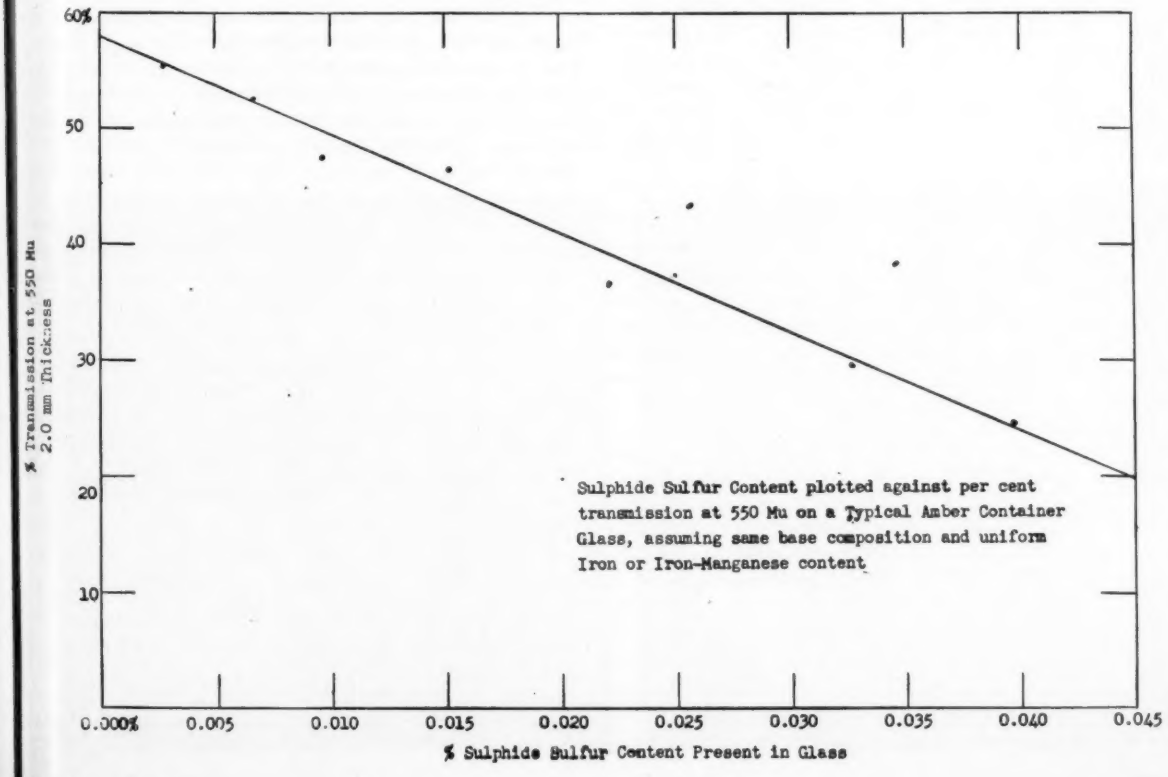
Analytical data on amber glasses as to the amount of sulphide sulfur remaining in the glass would indicate that 90% oxidation of all sulfur present is a little high. Actually, the amount of sulfur retained is proportional to reducing influences present in addition to sulfur and a certain amount has to be present to produce the amber color. Degree of color or intensity of the amber color being produced also must be designated in any interpretation of extent of sulfur oxidation. Graph 2 illustrates the influence of sulphide sulfur on intensity of amber color on a typical amber glass. Data is plotted as per cent transmission measured at 550 Mμ versus sulphide sulfur content. It is assumed that base composition and iron content remain constant since both would have some influence on amount of sulphide sulfur retention. Further interpretation of this data indicates that amount of sulfur oxidized at any given level of color would be as follows:

Transmission at 550 Mμ	% S retained
20%	37%
30%	27%
40%	17%
50%	7%

Oxidation of sulfur is by far the main cause of color variations. Furnace atmosphere, variation in furnace pull, variation in cullet ratio, all will have some influence towards greater or lesser amounts of sulfur oxidized.

(3) Iron. Variation in iron content of raw materials or mixed batch causes variations in amber color but not in the order of importance usually attributed to iron. As stated previously, an increase in ferric iron will result in greenish tints. In Table I it will be noted that iron as FeO, Fe_2O_3, and Fe_3O_4 is listed as both a color darkening and color lightening influence. This situation has its origin in the fact that if sufficient sulfur is left unoxidized, then some of the iron will form FeS color forming groups and result in increasing intensity of color. If, however, the degree of sulfur oxidation is high, then iron additions become relatively meaningless since there is already sufficient iron present to form the smaller number of FeS groups. Another way to express this same thought would be that an increase of iron in an oxide form to an already light amber glass would result in an even lighter glass *unless* some means of increasing over-all reducing conditions during the melting process were found. Con-

GRAPH 2.



versely, an increase in iron in the oxide form to an already dark amber glass would result in a darkening due to the fact that a greater number of FeS groups could be formed. Even more simply stated, iron oxide additions with increasing oxidation mean lighter glass; iron oxide additions with increasing reduction or more sulfur retention mean darker glass.

(4) Fluorspar (CaF_2). Lyle's work has shown that increasing fluorspar content from 1 to 15 parts per 1000 parts of sand definitely deepens the intensity of the amber color. Loewenstein[7] has offered the theory that this is a result of loosening the silica network, allowing the formation of longer sulfur chains in the glass structure.

In addition to the possible structural change, we feel that oxidation-reduction influences are playing important roles in this darkening effect also. Only approximately fifty per cent of the total fluorine present in a glass batch is finally retained in the glass structure, the balance being volatilized. Practically speaking, it would seem that a good portion of the CaF_2 present would be acting as a reducing agent according to the following equations:

#1—$2\ FeS + 3\ O_2 \rightarrow 2\ FeO + 2\ SO_2 \uparrow$

#2—$FeS + O_2 + 2\ CaF_2 \rightarrow FeS + 2\ CaO + 2\ F_2 \uparrow$

equation 1 being a color destroying reaction, equation 2 being a color preserving reaction. With furnace firing being oxidizing, addition of fluorspar would have a reducing effect over and above structural changes.

(5) Manganese (MnO_2 or MnO). The European trend, particularly in Germany, has been to shift to manganese-iron combination to produce the amber color instead of carbon-sulfur colorants. This trend came about largely because of increased glass stability and in spite of increased cost.

Manganese as MnO or MnO_2 is definitely a color darkener. To attempt to theorize as to why it is a color intensifier is just as difficult as is the case with fluorides. There is some evidence that sulphide sulfur is much less susceptible to oxidation when manganese is present and color variations as a consequence are minimized. Manganese seems to be a better stabilizing influence, insofar as sulphide sulfur retention, than is iron. Manganese also offers more advantages on viscosity and melting considerations.

(6) Increased furnace pull and furnace atmosphere. The point of main sulfur oxidation occurs at the doghouse and as the batch piles melt out or at the first two ports on a four-port furnace. Some degree of reduction is necessary to retain the amount of sulfur required to form degree of color wanted. This point in the furnace is where we introduce and burn 60% of the fuel used. Of a consequence, the degree of excess air used in fuel combustion is bound to be of major importance to amount of sulfur retained and resulting depth in color. It is at this point where we oxidize from 70 to 95% of all the sulfur present in the batch. Degree of sulfur oxidation will depend upon amount of reducing agents present, amount of excess air present, and with length of time batch piles are exposed. Increased furnace pulls shorten exposure time and result in less sulfur oxidation. Furnace age will also have an effect upon this phase of sulfur oxidation as would type of batch charging.

(7) Purchased or foreign cullet. It is our belief that everyone who has been connected with melting amber glass has had at some time or other the experience of dark amber glass directly traceable to dirty cullet. The reducing influences which result in greater sulfur retention are plain organic matter, rags, paper, bottle caps, both iron and aluminum. Even washed foreign cullet will often have some reducing tendencies and darkening influence. Iron present is usually of the metallic variety and therefore reducing, as well as furnishing a source of iron to combine with sulfur.

(8) Annealing. Bacon and Spix have proved that the color of commercial amber glasses are affected reversibly by heat treatment and that transmittance is influenced by both time and temperature of annealing lehr. It was their feeling, however, that color variations of this type would not be important to routine control of color since color changes are usually of a low order with normally good annealing. Their work, however, is quite valuable in studying possible structural changes and definitely a factor in evaluating small experimental melts as far as color intensity is concerned.

The influence of thermal history may have other influences if heavy metals such as Pb, Ni, Cr, or Cu accidentally find their way into the batch. Weyl cites such a case wherein an amber glass darkened, in some cases even became black, if its working had required repeated heating and cooling. Remelting or reheating to relatively higher temperatures made the amber color reappear, and this process could be repeated several times. The reason for this defect was that, accidentally, lead-containing cullet was used so that the resulting glass contained an appreciable amount of lead. Under these conditions, PbS formed which was responsible for the black color.

b. Color Destroyers or Modifiers.

(1) Furnace atmosphere. So far we have tried to point out that practical considerations are quite important in controlling amber color. Amber glass color depends upon retaining sulfur as sulphide or combined sulfur. We have shown that furnace atmosphere can oxidize anywhere from 60% to 95% of all sulfur present. This then is the most important single factor in controlling color or setting up a batch to give a particular color intensity. In comparing different types of furnace atmospheres, it is estimated that an average producer gas system would oxidize from 40% to 50% of all sulfur present, while the average natural gas atmosphere would oxidize 70% to 80%.

(2) Presence of Oxidizing Agents. Oxidizing agents added to the glass batch, such as Na_2SO_4, $CaSO_4$, $BaSO_4$, and $NaNO_3$, will eventually destroy the amber color if sufficient quantity is added just as surely as reducing influences such as carbon, sulfur, metallic iron, etc., will cause color to darken. The general equations are as follows:

#1—$2\ Na_2SO_4 + C \rightarrow 2\ Na_2O + CO_2 + 2\ SO_2 \uparrow$

#2—$3\ Na_2SO_4 + FeS \rightarrow 3\ Na_2O + FeO + 4\ SO_2 \uparrow$

Equation 1 would be a fairly rapid reaction which results in destroying the reduction necessary to prevent excess oxidation of sulfur. Equation 2 would be a fairly slow reaction since the sulfur is combined and comparatively stable. The inclusion of a small amount of oxidiz-

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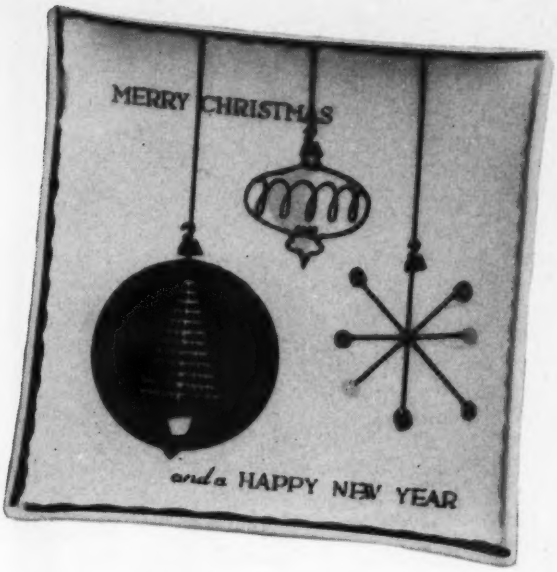

HOUZE ADDS DECORATING TO DIVERSIFIED PRODUCTION

Now entering its second half century, the L. J. Houze Convex Glass Company is living up to the reputation of its versatile founder, Leon J. Houze, whose inventive genius blazed new trails in various types of glassmaking.

While the company is well known for its pioneering and leadership in colored glass—especially sunglass lenses —the trade and general public is just beginning to learn about its real product potential. The company's range of diversification seems limitless.

Last year it was revealed that Houze was the only plant in the country able to duplicate, for quality and method of manufacture, the windows as they were originally installed in the White House when it was first built. The search for "hand-blown, hand-flattened" window glass was no minor problem, but after an exhaustive canvass of glass plant facilities in the country, it was apparent that this type of glass craftsmanship was only available from the Houze factory.

At its 50th anniversary celebration last fall, the company announced the first "atomic goggle," developed specifically for protection against atomic radiation and glare, for use by workers in the atomic energy industry, the Armed Services, X-ray laboratory technicians, and civilian defense workers. The company is also producing a special glass for television tubes to be manufactured under license from the Pittsburgh Plate Glass Company. The glass is to be used as the "face plate" on metal television tubes.

Roger L. Houze, II, head of the Decorating Department, shows a display of typical giftware manufactured under the tradename of Houze-Art. Closest to Mr. Houze on the table are a square and round plate bearing full-color photographs of a girl. At bottom left, the black objects are cigarette containers of pressed glass air-brushed with gold leaf. Most of the other flat items were made from hand-blown cased opal "white-on-crystal" glass.

Destined to make headlines for sunglasses this year is the new Houze neutral glass just announced after eight years of research. This glass, according to E. V. Ogg, Executive Vice President, to be called the "Natural View" lens, is an "all purpose" sunglass lens which reduces sun glare with no loss of color values. It is the only neutral lens popularly priced for the mass market.

Offhand, there wouldn't seem to be any connection between glass for viewing X-rays and glass Christmas cards. Yet, for a number of years the hand-blown department of the Houze company has been specializing in and turning out cylinders of opal cased on crystal glass, as well as other specially colored glass which, when flattened and cut, eventually wound up as X-ray glass and various technical commodities. Within the past several months, this very same glass, after applying silk screen and decalcomania designs, was formed into shape in special firing kilns to become permanent handsome greeting cards.

This unique discovery in the ultimate uses of cased opal glass demonstrates the way this 50-year old glass company has found a method of attracting new revenue by creating a Decorating Department. Recently expanded, the department already seems destined to do a sizable percentage of future business.

The Houze company is the largest and oldest manufacturer of colored glassware in the United States. Houze produces more than 700 different shades of colors in glass, whether pressed, hand-blown, or machine drawn. A good percentage of Houze production today is making various colored lenses for sunglass manufacturers. Houze also makes a considerable amount of specialty glass like the cased opal X-ray glass mentioned above, cover glass for medical microscopic studies; glass for welding goggles, watch crystals, signal semaphores, mirror blanks, and the like.

In addition, the company has always done a profitable business in the pressed glass department, turning out such quality items as ash trays, cigarette containers, lamp parts, fruit bowls, and a wide range of gift items for private manufacturers to sell to retail outlets through jobbers or directly. Until recently, Houze rarely sold any gift items under its own brand name.

The possibility of converting some of these special glasses into a bent gift line was thoroughly studied and it was concluded that they themselves possessed rare aesthetic qualities. Thus, it was of greatest importance to find methods of applying permanent designs, photographs, and other artistic illustrations to this type of glass.

After considerable research into ways of developing additional design to glass, there evolved three basic ways: by decalcomania, silk screen application, and hand painting or spraying, followed by special firing in kilns. Even photographs could be, and have been, permanently and successfully transferred, in monotones and polychromatic renditions, to the glassware by the decalcomania method. Houze also learned how to sandblast designs on cased opal glass so that the jet of sand etched the design through the opal layer, exposing the under crystal layer, to give a cameo effect, or intaglio.

It was found that the hand-blown cased opal glass, such as made for X-ray viewing, lent itself perfectly with outstanding results to the silk screen and decal art application, especially when coupled with sandblasting, while the pressed glass, because it lacked sufficient flat surface in many instances to take decals or silk screen

Fig. 1. The girl on the left is applying a special decal varnish to a blank glass square preparatory to applying the decal. The varnish is allowed to dry sufficiently until it is "tacky." The girl in the lower right corner then applies the moistened decal, brushing it even. The corner girl sponge-dries the square, which is then placed in the rack in the middle of the table, and placed in a low heat oven for pre-drying.

Fig. 2. The squares, now sufficiently dry, have a dark green artistic border applied by a silk screen "press." The girl has mixed the color, using a special powder, and has squeegeed it on the silk screen, allowing only the design to penetrate.

impressions, was best decorated by hand painting, acid etching, air-brushing, or spraying.

The company began experimenting with a few gift items, chiefly as trays and decorative plaques. The possibilities seem limitless. As the accompanying illustrations show, the company has already turned out a wide range of gift items—small square ash trays with early American automobiles and stagecoaches, fish flies, game birds, riders, and the like; crimped candy dishes with floral designs; plates with photographs of tourist attraction; portrait plates or platters; cigarette boxes in ebony black glass with gold-sprayed patterns, etc. Not shown are souvenir ash trays made for business firms, calendars, and gay cartoon squares. Up to now, all of these items were made on order from specific gift companies which sold them, or for business houses which distributed them as goodwill gifts. Finally, Houze plunged and made up the glass Christmas "card" shown in the accompanying illustration. The response to this was so great that a full-fledged decorating department was expanded under the direction of Roger J. Houze, II, grandson of the founder. Now, plans include turning out a number of items under the company's own brand name, "Houze-Art," for sale through distributors to retail dealers and department stores. Full scale effort is being put forth to package these items in attractive gift boxes, either grouped or individually, for presentation to the trade. Houze is confident this entire line will meet with acceptance. One item which was turned out—old automobiles on bordered squares of glass—was put on sale in the Vendome Gift Shop of Kaufmann's Department Store in Pittsburgh,

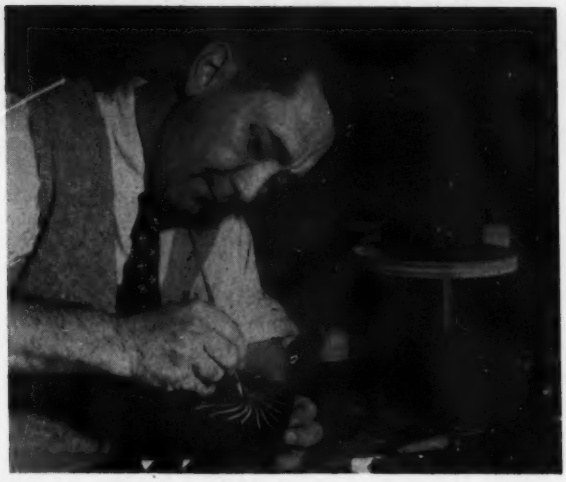

Fig. 3. The artist hand-paints a pattern on a pressed glass cigarette box which won't take either decals or silk screen impressions. On the right are other boxes on which gold flakes have been air-blown with the instrument shown under the circular stand.

after another manufacturer mounted them in leather frames and boxed them attractively.

The basic steps in making this decorative ware are as follows: (1) A gift manufacturer or business firm (or the Houze product design or sales department) comes up with an idea possibly giving illustrations of art; (2) Houze art department prepares various sketches in color for approval, whichever the case, including scale drawings of the subject itself, showing shape and contour; (3) After approval of the sketch on detailed drawing, the art department produces from clay, and then plaster, an exact model of the proposed mold; (4) At this point, the

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Fig. 4. The art work completed, the opal glass squares are placed on a slowly moving conveyor, one to a mold mounted on a spindle. They move through the special lehr, passing under a battery of flames, fed by natural gas, which have a temperature of 1350°F. The heat causes the glass to soften slightly and the suction created under the square and the mold causes the glass to bend to the exact concave form of the iron mold. These molds are completely interchangeable. The girl on the right checks each ash tray for imperfections in the color fixation. The color is permanently baked onto the glass in this manner and is stain-, damage-, and corrosion-proof.

THE STRESS-OPTICAL COEFFICIENT OF PLATE GLASS

By ROY M. WAXLER

Information in the literature on the stress-optical coefficient of different types of glass is quite limited, being restricted almost exclusively to data on optical glasses and not extending to large tonnage products such as plate glass. It was, therefore, deemed desirable to undertake an investigation into the stress-optical characteristics of a typical plate glass sample.

In order to determine the stress-optical coefficient of a specimen of glass, it is necessary to measure the optical path difference produced by a stress exerted upon the specimen. While there are several methods which may be used for this purpose, the one offering the most accurate measurement consists in arranging the specimen with other birefracting plates in such a manner that the combination acts as an optically rotary substance. By this means, a beam of plane polarized light after passing through the combination will still be plane polarized, but the plane of polarization will be rotated, and the amount of this rotation is proportional to the optical path difference of the material being investigated. This method of simulating an optically rotary medium was first established by Friedel[1], and later used by Goranson[2], in designing a polarimeter with which it is possible to measure optical path difference with errors less than 0.04 millimicrons.

The arrangement consists of a monochromatic light source, a polarizer, a specimen of glass with one of its principal directions set at 45° to the vibration direction of the polarizer, a quarter-wave plate with one of its principal directions parallel to the vibration direction of the polarizer, and, finally, an analyzer. If the specimen is stressed, there will be a rotation of the plane of polarization as viewed through the aforementioned series. The angle through which the plane of polarization is rotated is equal to one-half the phase angle, and may be used as a measure of the path difference in the specimen[3]. The arrangement planned for the following study is shown schematically in Fig. 1 with arrows representing the vibration direction of the fast ray for the specimen and for the quarter-wave plate.

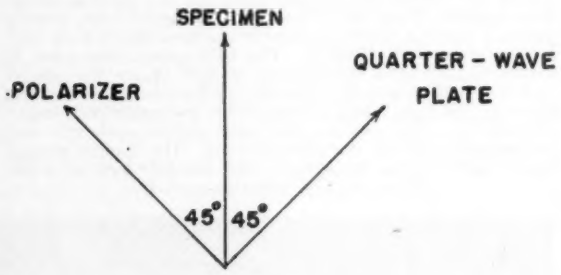

Fig. 1.

The actual arrangement of the apparatus used is shown in Fig. 2. All equipment was placed on a flat table, four feet in length, and the mountings were made with laboratory ring stands and clamps. The light source consisted of a mercury arc lamp with a green filter which produced monochromatic light with a wavelength of 5461 Ångström units. The lamp was covered with a metal shade pierced by a pin-point.

The plate glass under investigation had the following composition:

SiO_2	—	72.0%
R_2O_3	—	0.1
CaO	—	11.1
MgO	—	2.1
Na_2O	—	13.7
SO_3	—	0.5
Minor Ingredients	—	0.5
TOTAL	—	100.0%

A specimen of this glass was carefully cut and ground. Its dimensions were 1.232" x 1.213" x 3.75". The specimen was specially annealed for the purpose of reducing forming strains. Examination showed that some residual strain was present, but it was assumed that this slight residual strain would not affect the results.

The polarizer and analyzer were parts of a polarimeter which had been disassembled for the purpose of this experiment. The analyzer had a graduated circle with a vernier attachment which permitted reading to one-tenth of one degree. A quarter-wave plate was placed between the specimen and the analyzer. When using mercury green light, this plate was known to be accurate to ± 4% according to the manufacturer's specification. According to Goranson and Adams[2], such an uncertainty in the quarter-wave plate would have a negligible effect on the accuracy of measuring the optical path difference in the specimen.

Calibrated fifty-pound weights were used to apply a load on the glass. The mechanism employed consisted of a vertical steel shaft supporting a horizontal yoke and suspended loading platform.

To attain uniform distribution of the load, a ball bear-

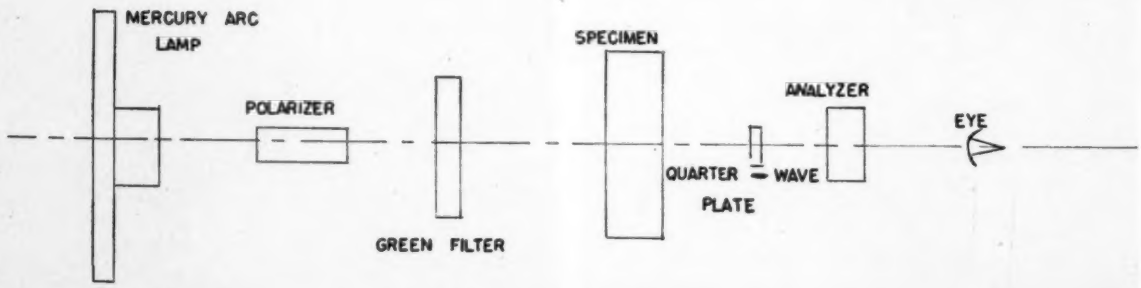

Fig. 2. Arrangement of apparatus.

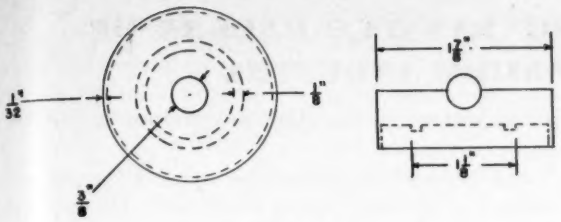

Fig. 3.

ing inserted in the socket of a metal disk was used. The metal disk, as shown, was cut to fit the specimen and had a raised circular lip which contacted the glass surface (Fig. 3). This combination of ball bearing and metal disk was used both where the shaft brought weight to bear on the glass and where the glass rested on a steel support.

A steel cylinder supported on levelling screws formed a frame for the entire loading device (Fig. 4). A steel bearing was welded to the top of the cylinder to support the shaft, and a flat steel plate was welded near the base of the cylinder to support the glass specimen. Two holes were cut into the walls of the cylinder that they might provide windows for the passage of the light beam through the glass.

By using a spirit level and adjusting the levelling screws at the base of the steel cylinder, it was possible to attain a horizontal surface upon which to rest the glass specimen. The specimen, being then in a vertical position, was in alignment with the direction of the force created by the load. This line of force established the directions of the planes of polarization of light transmitted by the glass.

It was also necessary to have some base point on the graduated circle of the analyzer in order to orient the polarizer and quarter-wave plate in forty-five degree positions. For this purpose, a Wollaston prism[4] was placed in the light path as it emanated from the source. Such a prism produces two beams of plane polarized light with mutually perpendicular vibration directions, and, since these beams appeared as small circular dots when projected on a screen, it was possible to turn the prism so that one vibration direction was horizontal while the other was vertical. When this had been done, one of the beams of polarized light was covered, the analyzer was placed in the light path, and the extinction position noted on the graduated circle. This extinction position was used as a base for subsequent settings of the polarizer and quater-wave plate (see Fig. 1).

Each piece of apparatus was set at the proper angle and was further adjusted so as to be perpendicular to the light path. This latter setting was accomplished by noting the reflection of light from all surfaces and making certain that the reflected beam of light coincided with the incident beam.

In conducting the experiments, the glass was weighted with a tare consisting of the steel shaft, yoke, and loading platform; the extinction position of the analyzer was noted; then a fifty-pound weight was added to the loading platform, and another extinction position noted, allowing about five minutes between readings. This process was repeated with fifty-pound weight increments, up to a maximum load of two hundred and fifty pounds.

It was hoped that the apparatus would measure optical path difference accurately to one millimicron, but since readings could not be duplicated exactly, ten observations were made with each load, and the mean value determined in each case, the tests being performed in a darkened room.

The stress-optical coefficient, c, is related to the retardation, r, the stress, t, and the thickness of the specimen, d, by the equation:

$$c = \frac{r}{td}.$$

Using the metric system of units, r may be expressed in Ångström units, t in bars, and d in millimeters. In which case, the stress-optical coefficient, c, is measured in brewsters.

If Δ w is the load increment in pounds, and b the width of the specimen in inches, we obtain:

$$c = \frac{rb}{1.752\Delta w},$$

where the number, 1.752, is a conversion factor for the units employed. The retardation may be expressed in terms of the angle through which the plane of polarization is rotated, according to the following equation:

$$r = \frac{2\Delta y\lambda,}{360}$$

where:

$2\Delta y$ is twice the rotation of the analyzer in circular degrees, while λ represents the wavelength of the light in Ångström units. The number, 360, represents the number of degrees in a circle.

Using the following numerical values:

$b = 1.232''$

$\lambda = 5461$ Ångström units,

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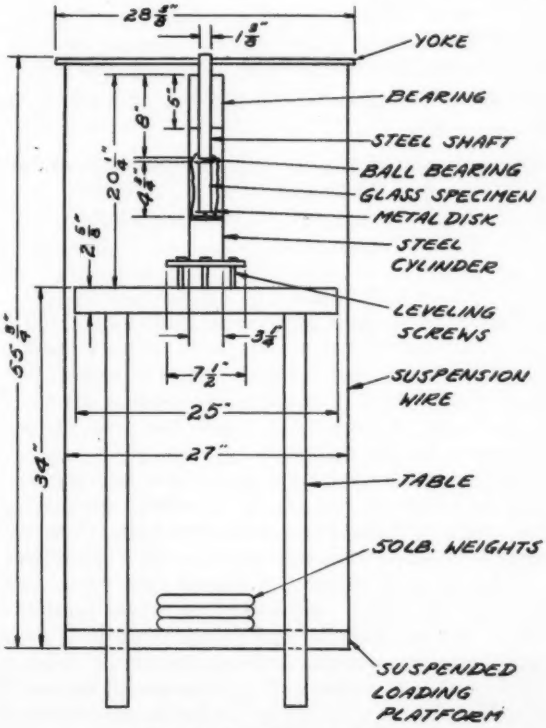

Fig. 4. Loading apparatus.

RECENT TRANSLATIONS OF RUSSIAN PAPERS OF INTEREST TO THE GLASS INDUSTRY

Abstracts of four papers which appeared in the Russian journal of the glass and ceramic industries.

NEW RAW MATERIALS FOR GLASS MANUFACTURE

Much attention is now paid in Russia to utilization of substitute raw materials, either to eliminate costly ingredients or to avoid long transport.

A very radical step was tried out in Ukraine and described by E. M. Kalenov and T. T. Trotsko in *Steklo i Keramika (Glass and Ceramics)* 9, No. 4, p. 3 (1952). Goods usually made of glass were produced from molten and then solidified special clays.

These clays are available locally. They are classified as spondylic clays. They are above all characterized by the high content of calcium carbonate which may be as high as 30% and always exceeds 10%. The main minerals making up these clays are quartz, calcite, glauconite, and pyrite, while mica, gypsum, tourmaline, and magnetite are less common, and apatite, rutile, and ilmenite are present in very small amounts. The composition of the clays changes with the depth in a nearly regular manner thus enabling the manufacturer to select the most suitable clay. The two deposits used in this work had the following compositions:

	Staikov clay	*Petrov clay*
SiO_2	33.6%	55.2%
TiO_2	0.35%	——
Al_2O_3	8.0%	10.6%
Fe_2O_3	3.2%	4.0%
CaO	27.5%	12.0%
MgO	1.1%	1.4%
$Na_2O + K_2O$	1.4%	1.4%
SO_3	0.3%	1.4%
Ignition loss	24.6%	14.0%

The degree of dispersity of these clays is shown by the following data:

Range of particle sizes	*Amount in the clay*
less than 0.005 mm.	30-40%
0.005-0.01 mm.	18-35%
0.01-0.05 mm.	17-25%
0.05-0.25 mm.	4-10%
greater than 0.25 mm.	less than 1%

The spondylic clays melt between 1250 and 1300°C. (i.e. 2280° and 2370°F.), but must be heated to 1400°C. (2550°F.) if the melt has to be run into molds. On a rapid solidification, a dense glass-like mass forms. It is green and translucent in layers less than 1.5 mm. thick but is black in thicker layers.

Melting was carried out in pots of 300 kg. (660 lbs.) each, in a tank having area of 0.5 square meter (8 sq. ft.), and in a furnace of metallurgical type. In the latter, 0.3-0.4 ton of coke was spent to melt 1 ton of clay.

Molds of metal, fireclay, and earthenware were used. The inner surface of the fireclay forms was lubricated with a mixture of kaolin and graphite, and that of the metal form was smeared with a mixture of graphite and hematite in machine oil and kerosene. The molds were heated to 600°C. (1110°F.) before the batch was admitted.

Cast articles from molten clay included bars up to 1 meter (3.3 ft.) long, tubing of 35 mm. (1½ in.) wall thickness, and so on.

If the glass is cooled so slowly that the temperature interval 1000°C.-950°C. (1830°F.-1750°F.) is traversed within 1-1.5 hour, a microcrystalline material is obtained. Usually, however, several different clays must be blended and some mineralizers must be added to achieve this result. The material can be used wherever concrete is used. If the porosity of the material is 10%, its crushing strength is 1500-2000 kg. wt./sq.cm. (21000-28000 psi) and breaking stress in tension is 150-200 kg.wt./sq. cm. (2100-2800 psi). If the porosity is increased to 40% corresponding to the density of 1.56 (97.5 lb./cu.ft.), the strength is lowered to that of concrete, i.e. the crushing strength becomes 250 kg.wt./sq.cm. (3600 psi) and the rupture stress in tension, 25 kg.wt./sq.cm. (360 psi). The material can be covered with plaster of Paris, combined with cement, and so on.

The glass can be pressed at 1250-1280°C. (2280-4340°F.) and then annealed at 620-650°C. (1150-1200°F.). In this manner tiles, cases for storage batteries, funnels, door knobs, and so on were manufactured. The goods can be sandblasted, polished, glazed, and reinforced with metal nets. They have an excellent chemical endurance in water and acids, but become covered with a white efflorescence in alkaline liquids. Electrical insulators made of this glass are better than those of the customary glasses, as would be expected because of the low content of alkali metals in the former.

A Ukrainian plant manufactured bottles from this glass. The production seems, however, to have been discontinued soon, and starting from October 1951, bottles were produced from a batch composed from spondylic clay, sand, and 12% sodium sulfate; the relative amounts of clay and sand are not disclosed in the original paper.

Mineral wool was made on the basis of a clay containing SiO_2 61.5%, Al_2O_3 9.9%, Fe_2O_3 2.1%, CaO 11.8%, MgO 1.2%, $Na_2O + K_2O$ 1.3%, and ignition loss 12.1%. Non-specified additions were made to this clay, and the resulting filaments had the composition SiO_2 43.0%, Al_2O_3 10.0%, Fe_2O_3 4.6%, TiO_2 0.4%, CaO 39.8%, MgO 2.2%, and SO_3 0.1%. The properties of the wool satisfied the standard requirement. The density was 0.29, the amount of drops was 17.4%, sintering temperature above 700°; 80% of the filaments were finer than 7 microns (0.00028 inch), 19% were between 7 and 12 microns (0.00048 inch), and only 1% was coarser.

Spondylic clays were used also as the main raw material for the manufacture of multicellular glass ("foam glass"). The product was comparable to the standard foam glass: its density was 0.18 to 0.6 (i.e. 11 to 37 lb./cu.ft), the uptake of water 1.7-8.0%, and the crushing stress 13 to 117 kg.wt./sq.cm. (180 to 1700 psi). The procedure used was briefly as follows: clay as briquets or fragments of 10-15 cm. (4-6 in.) was molten in a small furnace, and the melt flowing out of the fur-

nace was broken to powder by a stream of cold water. The powder is mixed with 1-2% coke or chalk and, if necessary, sodium carbonate and then passed (in molds) through a tunnel oven in which the temperature is 650-800°C. (1200-1470°F.) in the first zone, 1110-1150°C. (2030-2100°F.) in the second, decreases to 620°C. (1150°F.) in the third, is constant at 620°C. in the fourth, and decreases to 40°C. (100°F.) in the fifth zone.

* * *

The utilization of "soda slags" in the glass manufacture was studied by M. I. Nekrich and Ya. P. Mostovoi, see *Steklo i Keramika (Glass and Ceramics)* 9, No. 4, p. 9 (1952). "Soda slags" are obtained by the desulfurization of pig iron with sodium carbonate. The sample chiefly used for the experiments contained

SiO_2 37.4%, Al_2O_3 4.5%, FeO 4.2%, CaO 11.1%, MgO 3.9%, Na_2O 34.9%, MnO 2.3%, S 1.7%.

The batch used for glassmaking consisted of sand 75.0, chalk 6.8, sodium sulfate 10.4, and "soda slag" 44.1 parts. The composition of the first three ingredients is shown below:

	SiO_2	R_2O_3	CaO+MgO	Na_2O	NaCl	SO_3	ignition loss
sand	87.40	9.05	1.31	0.95	.....	0.55	0.74
chalk	13.45	2.30	47.17	.....	.....	.....	37.08
sulfate	2.38	0.24	1.13	41.1	0.57	52.98	.....

The batch was melted in pots of 10 kg. (45 lb.) capacity. The resulting glass contained SiO_2 66.7%, R_2O_3 8.4%, RO 9.2%, Na_2O the rest. Bottles made of this glass were up to the specification as far as their mechanical and thermal endurance was concerned. However, the glass was dark and could be used for products usually marketed in dark containers.

* * *

Substitution of sandstone for sand was investigated in the Pacific region of U.S.S.R. which is short of pure quartz sand. E. P. Ozhigov, K. G. Maidel and A. N. Dorokhina report the results of this work in *Steklo i Keramika (Glass and Ceramics)* 9, No. 4, p. 10 (1952).

The chemical composition of the sandstone used varied within the limits shown below

	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO
Littoral sandstone	80-90%	7-12%	0.5-0.8%	1.8-2.0%	1.5-2.6%
Krasnoyarsk sandstone	89-96%	1-6%	0.07-0.7%	0.5-1.3%	0.1-0.35%

Mineralogically, the rocks consisted of quartz grains cemented together by felspar or clay, or both. The grains were 0.13-2 mm. large in the Littoral, and 0.1-0.5 mm. in the Krasnoyarsk sandstone.

The separation of quartz from cement was performed according to this flowsheet:

sandstone
↓
comminution by manual work to fragment of 50 mm.
↓
mechanical comminution down to the size of the quartz grain
↓
loosening of cement from quartz by
↓ ↓
a wet method (with water in a ball mill) | a dry method (in rotating drums)
↓ ↓
fractional sedimentation in water | fractional sedimentation in air current
↓ ↓
drying | drying.

In a laboratory process, the yield of purified sand was 50-70%. The longer the grinding, the purer the resulting quartz, but the smaller its yield. The process was considered complete when the water triturated with the powder in a mortar remained clear. The powder was white or slightly greyish, and no cement was visible on the grains under a magnifying glass. The chemical composition of the powder obtained by the wet method was

	SiO_2	Al_2O	Fe_2O_3	CaO	MgO
Littoral	95-96%	2-3.5%	0.15-0.25%	0.30%	0.20%
Krasnoyarsk	95-99%	0.4-2.4%	0.05-0.13%	.....	.....

Thus, the treatment reduced the sesquioxide content to about one-third of the original. The dry method was more time-consuming and resulted in a less pure quartz powder. The composition of the latter was

	SiO_2	Al_2O_3	Fe_2O_3
Littoral	94-95%	3-4.3%	0.2 -0.4 %
Krasnoyarsk	97-98.7%	1.0-2.4%	0.08-0.12%

On the other hand, the dry method requires a particularly simple equipment.

The sand from sandstone was successfully used for large-scale manufacture of glass. The glass had but a weak greenish color.

The sandstone residue, mixed with 5% Chasov—Yar clay and heated to 1280°C. (2300°F.), yielded tiles characterized by high strength (no quantitative results are given in the original paper).

PRINCIPLES OF THE CONSTRUCTION OF BURNERS

E. & V. Pototskaya discusses these principles in *Steklo i Keramika (Glass and Ceramics)* 9, No. 5, p. 11.

The action of a burner depends on the length, the direction, and the position of its flame.

(1) The length of the flame depends above all on the rate of flow of the gas-air mixture. This dependence is illustrated in Fig. 1 based on Kitaev's work on metallurgical burners. The rate of flow is plotted along the abscissa (in meter/sec.) and the length of flame (in centimeters) along the ordinate. The upper curve is for a gas whose combustion yields 10184 kg.cal. for cubic meter (at NTP) and the lower curve for a gas of 1404 kg.cal./cubic meter. (One kg.cal. per cubic meter is equal to 0.1124 BTU per cubic foot.) As the rates employed in glass furnaces usually are confined between the limits marked on the graph (α and δ), it may be stated that the length of flame linearly increases with the rate of flow.

The flame is shorter the better the intermixing of gas and air before they reach the flame. The momentum (i.e. the product of mass and velocity) should be identical for gas and air in horizontal channels. Hence, the ratio

Effect of oxidizers on light transmission

COMPOSITION								LIGHT transmission	FeO/(FeO + Fe_2O_3)
Fe_2O_3	CaO	Na_2O	K_2O	BaO	As_2O_3	Sb_2O_3	B_2O_3	%	
0.1	12.0	14.2						84.7	0.43
0.1	12.0	12.2	1.0	0.5				86.6	0.29
0.1	10.0	12.2	1.0	2.0				87.3	0.20
0.1	12.8	13.2	1.0		0.25			89.2	0.14
0.1	12.8	13.2			0.30			88.9	0.18
0.1	12.8	13.2				0.3		89.4	0.16
0.1	12.8	13.2				0.6		89.7	0.15
0.07	12.3	13.2	1.0				0.5	89.4	0.14
0.09	11.5	14.2		0.5	0.25			87.6	0.18
0.09	11.5	14.2		0.5	0.5			88.7	0.13
0.10	12.8	13.2			0.2	0.2		88.9	0.17
0.07	12.3	13.2	1.0		0.25		1.0	89.4	0.13

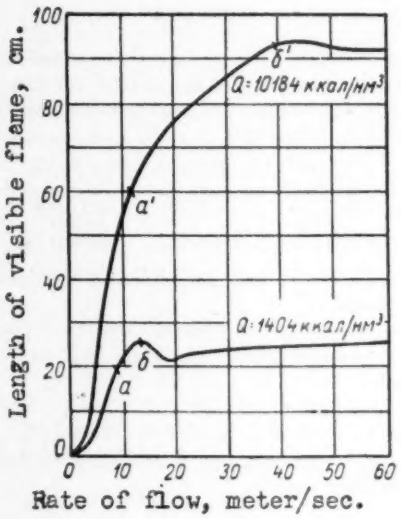

Fig. 1.

of the velocities (air to gas) should vary from 1.06 for gas to 1000 kg.cal./cu. meter, having a temperature 100°C. above that of air, to 0.47 when the gas has 1250 kg.cal./cu. meter and is 100°C. cooler than the air.

The flame is shorter the longer the path of the gaseous mixture in the mixing chamber in which, in addition to mixing, combustion also starts. An excess of air reduces the flame length but also lowers the flame temperature. Preheating of gas and air shortens the flame and is beneficial in all respects.

Experience of glass works shows that when the rate of flow reaches 12 to 13 meters per second, corrosion of the refractories becomes excessive. When the tank width is 5 to 7 meters, the most advantageous rate of flow is 6 to 9 meters/sec.

The roof of the air duct should be inclined to the horizontal at 15 to 20°, and the floor of the gas duct should rise 5 to 10°. Thus the angle formed by the two gaseous

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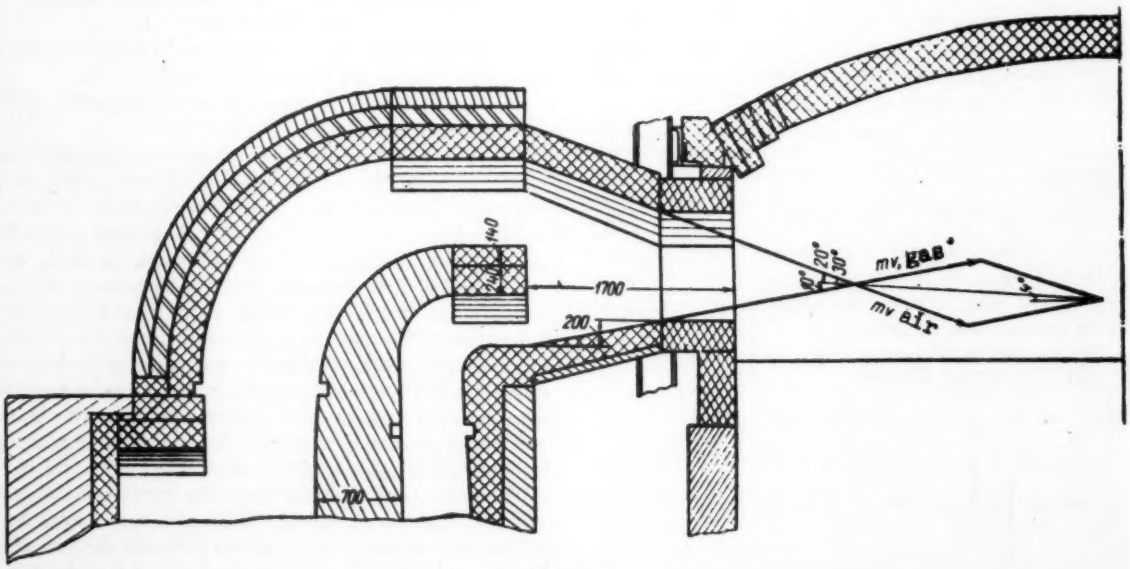

Fig. 2.

Inventions and Inventors

Furnaces

Refractory Port. Patent No. 2,628,088. Filed May 22, 1950. Issued February 10, 1953. Two sheets of drawings (none reproduced). Assigned to Kaiser Steel Corporation and Kaiser Aluminum and Chemical Corporation by Leslie W. Austin and John D. Isaacs.

A prefabricated removable burner port is made from a plastic-chrome-ramming mix. The port is prefabricated in the form of a rosette outside the furnace and then hoisted into position within the furnace. A minimum amount of time is lost in substituting a new ring for any defective one. This shape possesses exceptionally good spalling resistance as well as resistance to abrasion.

The patent contains three claims and 11 references were cited.

Glass Compositions

High Index Glassy Material. Fig. 1. Patent No. 2,628,-150. Filed October 24, 1951. Issued February 10, 1953. One sheet of drawings. Assigned to National Lead Company by Leon Merker and Langtry E. Lynd.

This invention relates to an optically glass-like material composed of strontium titanate. Strontium titanate melts in the neighborhood of 2100°C. and it is therefore preferred to use an oxygen-hydrogen torch in order to obtain the necessary temperatures. Finely divided strontium titanate particles are dropped into the area of intense heat formed by the oxygen-hydrogen torch. Within this area, the strontium titanate melts and when carefully cooled builds up as a single crystal on a base which holds the molten strontium titanate material. In order to start such a single crystal to form, it is desirable to first crystallize a small pool of strontium titanate material on the base and then gradually increase the amount of molten material on the top of the crystal so formed. Such a procedure allows the crystal to build up upon itself, gradually increasing in diameter until a carrot-shaped single crystal or boule of strontium titanate is formed.

The resulting glass-like material has an index of refraction of about 2.4 and a reciprocal dispersion of about 13. In Fig. 1 a comparison is made between monocrystalline strontium titanate, and crown glasses and flint glasses. It is clearly shown that the strontium titanate has index of refraction and dispersion distinctly apart from the range of values of either crown or flint glass.

The patent contains four claims and 12 references were cited.

Glass Wool and Fiber

Manufacture of Glass Fibers. Fig. 2. Patent No. 2,629,-969. Filed September 21, 1945. Issued March 3, 1953. One sheet of drawings. Assigned to Societe Anonyme des Manufactures des Glaces et Produits Chimiques de Saint-Gobian by Ivan Peyches.

Referring to Fig. 2, 1 designates the centrifuging body, 7 the openings from which the glass issues and x y the issuing plane of the fibers; 4 is the obstacle constituting a kind of mold around which the fibers are deposited; said mold is given a rotary movement around its axis 11 and also an alternative translation movement along said axis, the amplitude of the latter movement being equal to the height of the mold.

The support 13 bearing the mandrel 4 may be displaced on the framework 14 connected to the base 15 of the revolving body. The displacement of support 13 permits a varying of the distance from the mandrel to the centrifuging body. 16 shows the openings which are provided on the mandrel 4 and through which the minus pressure established inside the mandrel may be transmitted for drawing the fibers onto the mandrel surface.

To avoid interruption in the production, two identical receiving devices connected to the base 15 through an articulated parallelogram 17 to which the frameworks 14 supporting said devices are fixed. Thus the mandrel, which is covered with fibers, may be taken away from the zone of formation of the mats and a fresh empty mandrel may be substituted for it.

Vacuum may be established inside the mandrel by means of a pipe 19, connected to the axle 11a of the mandrel through the casing 18. The replacement of the mandrel by another one may be started as soon as the thickness of the mat on one of the mandrels has reached the desired value.

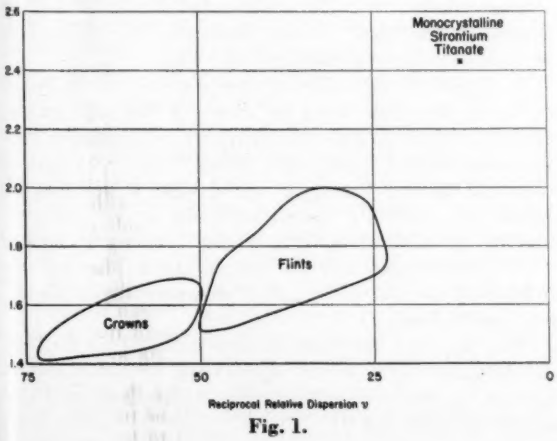

Fig. 1.

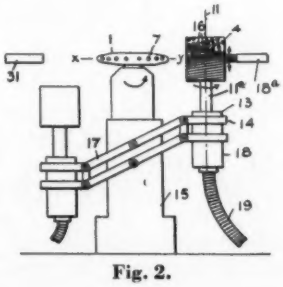
Fig. 2.

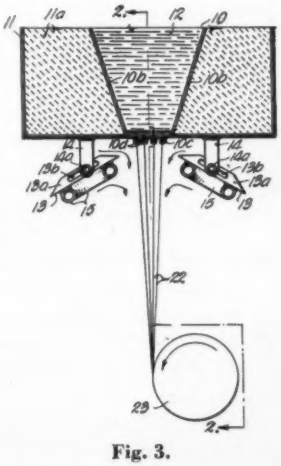
Fig. 3.

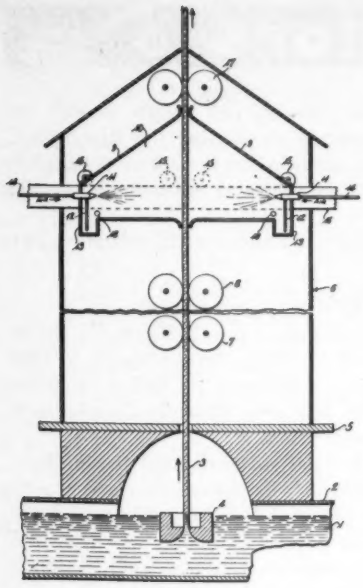

Fig. 4.

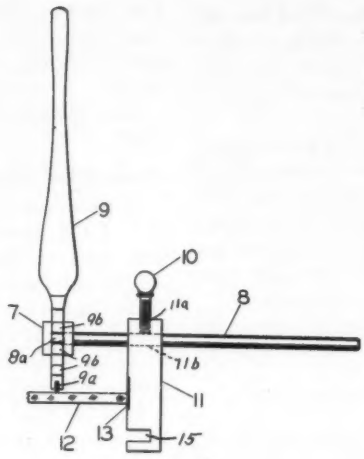

Fig. 5.

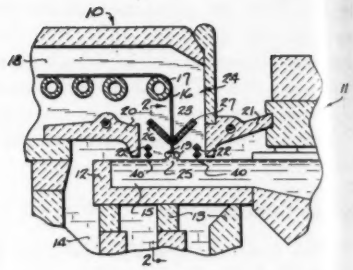

Fig. 6.

The patent contains 15 claims and the references cited were: 816,114, Morrison, Mar. 27, 1906; 2,187,094, Pink, Jan. 16, 1940; 2,234,087, Rosengarth, Mar. 4, 1941; 2,274,130, Davis, Feb. 24, 1942; 2,333,218, Von Pazsiczky, Nov. 2, 1943; 204,318, Great Britain, June 19, 1924; and 534,681, Germany, Oct. 5, 1931.

Fibrous Glass Manufacture. Fig. 3. No. 2,632,287. Filed February 10, 1950. Issued March 24, 1953. One sheet of drawings. Assigned to Gustin-Bacon Manufacturing Co. by Marion W. Phillips.

The melting unit shown in Fig. 3 is composed of a trough-shaped refractory unit 10 with a horizontal bottom 10C. In the bottom are a number of small orifices 10d arranged in lateral rows. The bushing is constructed of platinum which is chemically inert to the molten glass. Below the housing 11 are a pair of inclined baffle plates 13 disposed on either side of the bushing bottom 10c. With this arrangement, the baffle plates may be shifted toward or away from the orifices. To cool the baffle plates and control the temperature around the orifices, a U-shaped tube 15 is welded to the face of each plate. Water or any other appropriate coolant may be used as a coolant. The baffling and cooling arrangement thus provides a means of carefully controlling the temperature in the region of the orifices. The filament is collected on drum 23.

The patent contains seven claims and the references cited were: 2,175,225, Slayter, Oct. 10, 1939; 2,387,557, Modigliani, June 23, 1942; 2,335,135, Staelin, Nov. 23, 1943; 2,418,873, Fletcher et al., Apr. 15, 1947; and 2,491,889, Bennett et al., Dec. 20, 1949.

Sheet and Plate Glass

Improved Durability of Sheet Glass. Fig. 4. Patent No. 2,630,656. Filed November 23, 1951. Issued March 10, 1953. One sheet of drawings. Assigned to Adamston Flat Glass Company by William Meigs Kramer and Regis Florian Fey.

A method is presented for improving the durability of sheet glass and especially its stability in storage. In practice, a mass of molten glass 1 is drawn from chamber 2 as indicated in Fig. 4. The glass sheet 3 is drawn in the conventional manner from the drawing block 4 up through the spaced rollers 7 and 8. The glass is also moved through a spraying chamber 10. At this position, the moving sheet is sprayed with an organosilicon compound. A typical compound used was 0.02% to 2.0% by weight of hexadecylsilicon trichloride in trichloroethylene. Other organosilicones and other solvents, e.g., carbon tetrachloride, have been successfully used. The glass sheet should be maintained at a temperature of about 200°F. and the glass should pass through a chamber containing at least 1000 p.p.m. of the solution of organosilicon compound. The time required for the sheet to pass through chamber 10 was about 60 seconds. Glass so treated may be stored without the usual paper interleafing.

The patent contains 11 claims and the following references were cited: 1,680,227, Mambourg, Aug. 7, 1928; 2,177,000, Nash, Oct. 24, 1939; 2,306,318, Owen, Dec. 22, 1942; 2,413,050, Hyde, Dec. 24, 1946; 2,439,689, Hyde, Apr. 13, 1948; and 2,445,572, Gerould et al., July 20, 1948.

Glass Cutter. Fig. 5. Patent No. 2,629,174. Filed September 28, 1951. Issued February 24, 1953. One sheet of drawings. Domenic R. Corrado.

An improved manually-operated cutting tool is shown in Fig. 5. In order to cut or "score" a line adjacent the edge of a sheet of glass 12, provision is made of a conventional vertical glass cutter shank 9 having a cutting wheel 9a at the bottom provided with a plurality of horizontal, vertically spaced teeth 9b in the enlarged bottom end of the tool. The notches between the spaced teeth 9b may selectively be secured around the reduced cylindrical end 8a of the rod, 8, depending upon the desires of the user.

After the tool has been secured in the desired notch, the thumb set screw 6 (not shown) will be turned tightly against the rear wall of the cutter tool to lock said tool tightly upon the rod 8.

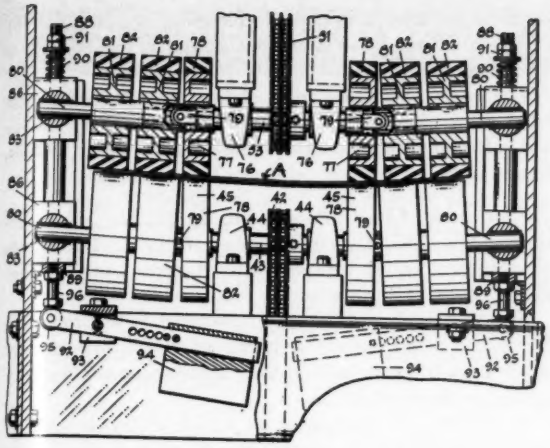

Fig. 7.

After cutting or scoring the line adjacent to the edge of the glass sheet 12, the edge of the glass is inserted within the slot 15 of the block 11 and twisted so as to insure fracture.

The patent contains two claims and no references were cited.

Apparatus for Drawing Glass. Fig. 6. Patent No. 2,631,410. Filed August 20, 1945. Issued March 17, 1953. One sheet of drawings. Assigned to Libbey-Owens-Ford Glass Company by John L. Drake.

An improved method for drawing sheet glass is shown in Fig. 6. A ribbon or sheet of glass 16 is drawn upwardly from the bath 15 and then bent into the horizontal plane over a bending roll 17, before being passed through a flattening chamber 18 and an annealing lehr not shown. Lip-tiles 20 and 21 and lip-tile coolers 22 are provided to protect the rising sheet from blasts of hot air from the pot chamber 14.

A pair of heat exchangers or sheet coolers 26 and 27 of somewhat unusual conformation are positioned one on either side of the rising sheet.

In addition to the particular shape of these coolers, and their arrangement relative to the sheet being drawn, they also have special finishes on certain of their surfaces. That is, the outer surface of the upper long side of each cooler is black while the surface of the lower long side is made shiny or reflecting.

The coolers of this invention, when arranged in the manner shown and described, perform a threefold function. In the first place they are close enough to the glass sheet to baffle or interrupt the convection currents that would be naturally set up along its heated surface. Secondly, the coolers will set up a controlled air flow in a direction counter to the natural convection currents in this area, and finally they will exert a positive and uniform radiant cooling action on the sheet across its entire width at the critical point in its formation.

When properly handled, sheet drawing machines in which this invention is incorporated will produce sheets that are noticeably higher in quality and of much more uniform thickness. Moreover, because the cooling action is so uniform, the sheet being formed can be cooled faster, and consequently can be drawn at a higher rate of speed for any given thickness.

The patent contains five claims and 12 references.

Curved Laminated Safety Glass. Fig. 7. Patent No. 2,628,177. Filed October 8, 1948. Issued February 10, 1953. Four sheets of drawings. Assigned to Libby-Owens-Ford Glass Company by James H. Boicey and Carl B. Williams, Jr.

The principal object of this invention is to provide a special kind of roll type press in which the rollers apply substantial pressure against the surface of a transversely curved glass and plastic sandwich without developing appreciable bending stress in the curved sheets of glass.

Referring to Fig. 7, the lower shaft 43 and upper shaft 53 are journaled in rigid bearings 44 and 76 and are held parallel to each other. The outer ends of these shafts carry rollers 45 and 77, respectively. Each of these rollers carries a rubber tire 78, the rubber being sufficiently pliable in relation to the axial length of the tire so that it can accommodate the transverse curvature and slope of the glass occurring within its axial length. Thus, the cooperation of these rollers, 45 and 77, two on the ends of the lower shaft 43 and two on the ends of the upper shaft 53, both press and guide the glass laminate assembly A during its passage through the second or fourth roller press section. The resiliency of the rubber tires 78 in accommodating differences in thickness of the glass laminate assemblies makes it possible to fixedly mount the bearings 44 and 76 for the shafts 43 and 53 and thus simplify the construction of the press.

The patent contains nine claims and 16 references were cited.

Sheet Glass Washer. Fig. 8. Patent No. 2,619,098. Filed April 17, 1945. Issued November 25, 1952. Five sheets of drawings. Assigned to Libbey-Owens-Ford Glass Company by Emmett L. Walters.

A novel type of apparatus is shown in Fig. 8 that is

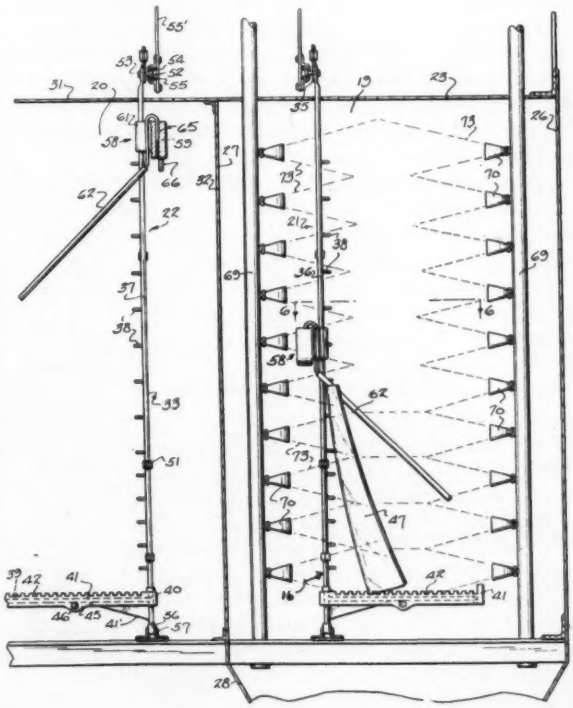

Fig. 8.

especially adapted for washing curved or bent sheets as well as plates of glass. The tunnel 15 (not shown) is made up of two longitudinally extending chambers 19 and 20 arranged side by side. The chamber 19 contains the forward flight 16 and the chamber 20 contains the return flight 22. The conveyor 16 is substantially L shaped in cross-section and provision for holding a curved sheet 47 firmly in place is indicated. Washing is accomplished by spray nozzles 70 which are projected on both sides of the washing chamber. The nozzles are fed by vertical pipes 69. The preferred cleaning material is a suspension of fine hardwood flour such as palm nut shell flour or walnut shell flour suspended in water.

The entire washer is divided into loading section, washing section, rinsing section, drying section, and unloading section. The functions of each section can be understood only after a study of the various drawings.

The patent contains seven claims and 16 references were cited.

Tube and Cane Machines

Television Image Tube. Patent No. 2,622,219. Filed July 7, 1950. Issued December 16, 1952. One sheet of drawings (none reproduced). Assigned to Hartford National Bank and Trust Company by Pieter Schagen.

Improved television transmitting tubes are provided having a novel form of image analyzing screen. These objectives are achieved, if in a television transmitting tube having a source of a directive electron beam, the image analyzing screen comprises a substance, the dielectric constant of which varies with variations in the intensity of the light projected onto the screen. This light-sensitive substance in the device of invention is applied to an electrically conductive surface of a carrier, and the opposite side of this substance is coated with a thin layer of insulating material. The directive electron beam of the tube scans this thin layer of insulating material occasioning a varying potential differential across the light-sensitive substance corresponding to the variations in the light intensity of the image formed on the screen. These potential variations are then converted to successive current variations which may be amplified in the usual manner for transmission.

Successful coatings for the screens have been made of a mixture of zinc sulphide and cadmium sulphide having variable dielectric constants and an insulating coating of silicon dioxide.

The patent contains nine claims and the references cited were: 2,013,162, McCreary, Sept. 3, 1935; 2,541,374, Morton, Feb. 13, 1951; and 271,401, Great Britain, June 16, 1927.

Fluorescent Lamp. Patent No. 2,622,221. Filed November 23, 1945. Issued December 16, 1952. Two sheets of drawings (none reproduced). Assigned to Westinghouse Electric Corporation by Norman C. Beese.

The principal object of the invention is to produce a fluorescent lamp having a filling of a mixture of rare gases of such a composition that fluorescence is efficiently excited in the phosphor.

A mixture of rare gases in which either helium or neon is selected as a carrying gas to make it possible to get good efficiency at practical pressures, and either krypton of xenon is selected to determine the intensity of the light generated by increasing the amounts of fluorescent-exciting radiations produced by the mixture.

While this is an easy requirement in designing a lamp for normal room-temperature operation, it prevents fluorescent lamps from being used outdoors in cold climates, or any place where the ambient is abnormally low.

Improved results have been obtained by the use of manganese-activated zinc silicate phosphors in which a mixture of rare gases such as helium and neon are used as carrying gases. Either krypton or xenon is selected as the light-intensity determining gas. The total pressure being between 1 and 2 mm. of mercury and the volume of the latter gases ranging from 2 to 2½%.

The patent contains three claims and 10 references were cited.

Machine for Sealing Ampuls. Fig. 9. Patent No. 2,629,970. Filed April 16, 1951. Issued March 3, 1953. Two sheets of drawings. James F. and Herman H. Kahlenberg.

This invention provides a means of sealing glass tubing by the application of heat and more particularly to the sealing of ampuls and like containers in which a long slenderized tube is flared at its tip to provide an enlarged funnel-shaped mouth. It is a continuation of U.S. Patent No. 2,493,070.

Referring to Fig. 9 the turret 4 is loaded with sealed ampuls and at least one ampul 17 is engaged and caused to revolve about its own axis by the belt 26. When the lips 47a and 48a engage an ampul 17, the slide 46 is in its upper position. As the ampul reaches the heating station "B", slide 46 moves down and at the same time the glass becomes molten. Member 46 functions as a

(*Continued on page* 281)

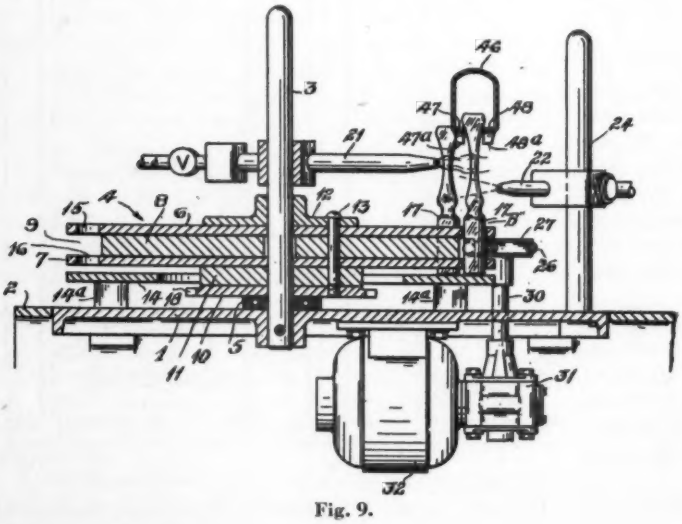

Fig. 9.

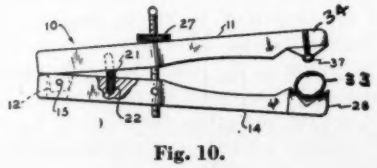

Fig. 10.

Radiant Glass Heating Panels

In recent years radiant glass heating panels have come into increasing use for heating residences and other small buildings. This type of panel was recently studied under controlled conditions by Paul R. Achenbach of the National Bureau of Standards under the sponsorship of the Housing and Home Finance Agency. The results of these tests indicated that electrically-heated radiant glass panels constitute a satisfactory method of warming a basementless house. However, even with the house thoroughly insulated, electric heating can be expected to entail higher annual heating costs in most areas than would coal, oil, or gas because useful heat derived from electricity has a higher unit cost than that produced from these common fuels.

The tests were conducted in the NBS Test Bungalow, a small one-story house of four rooms and bath, with a hallway near the middle of the structure connecting the rooms. The Test Bungalow is completely enclosed in an insulated structure with a five foot space between outside bungalow walls and the inner walls of the enclosure. Unit coolers in the enclosure allow the control of outdoor temperatures. Thermocouples, suspended at various levels throughout the house, were used with indicating and recording equipment to observe the temperature distribution in the house.

The typical radiant glass panel is mounted on a metal frame and backed by a reflective shield from which it is separated by a small air space. A metallic coating on the rear surface of the glass serves as the electric conductor and heating element. The output per panel is typically about 1000 watts. Panels are designed for either 115 or 230 volts AC, and are made for mounting beneath windows, as baseboard units, or as vertical units adjacent to window frames.

Heat is transmitted from glass heating panels primarily by radiation and convection. When the panel is heated above the room air temperature, heated air passes upward over the face of the panel, through the space between the glass and the reflective shield, and between the shield and the frame of the panel assembly. At the same time, radiant heat is emitted outward from the face of the panel. The passage of air through the spaces back of the glass keeps the temperature of the rear of the assembly cool enough to allow it to be in contact with combustible materials.

Ten radiant glass heating panels were installed in the Test Bungalow at the beginning of the tests; two under the double window of the living room, one under the single window of the living room, and one under each of the other windows of the bungalow, all located just above the floor level. The panels in each room were connected to separate electrical circuits and the room temperature of each room was controlled by means of an individual thermostat and relay.

The initial power demand for the panels was about 145 per cent of the steady demand after the panels became thoroughly heated. Approximately 20 minutes were required after starting to attain steady power demand and approximately 30 minutes were required to attain a steady temperature on the exposed glass surface. The temperatures at the centers of the glass plates operating at rated voltage averaged about 340°F.

The temperatures observed in the Test Bungalow for eleven different test conditions with constant outdoor temperatures in the range from 0° to 32°F. show that the vertical temperature differences in the living zone (2 to 60 inches above the floor) were moderately low, ranging from 3.5 deg. F. for an outdoor temperature of 32°F. to 7.0 deg. F. for an outdoor temperature of 0°F. Thus, the temperature gradient in the living zone was 0.7 deg. F. per foot of height at the higher outdoor temperature and 1.4 deg. F. per foot of height at the lower outdoor temperature.

The vertical temperature differences in the living zone with the radiant glass panels were about one to 2°F. greater than those observed in the same house with a baseboard convector heating system. Insulating the walls and adding storm windows did not significantly change the vertical temperature differences observed in this house. Since the same number of panels were in operation in the insulated and uninsulated condition of the house, the per cent of time during which the heaters were energized was appreciably less in the insulated house. Consequently, the chimney effect of the house and natural convection played a more significant role in the insulated house during the longer periods when the heaters were not energized than in the uninsulated house.

The maximum horizontal temperature difference between rooms was 1.6°F. for an outdoor temperature of 32°F. and 2.5°F. for an outdoor temperature of 0°F. when all levels of observation were considered in computing the average. The greatest variations between rooms usually occurred at levels 2 inches and 60 inches above the floor. Insulating the walls and adding storm windows did not significantly change the horizontal temperature variations within rooms and between rooms.

The heat loss of the Test Bungalow was 8.33 KW at an outdoor temperature of 0°F. when the walls were uninsulated and 5.18 KW when the walls were insulated. The relation between heat loss and indoor-outdoor temperature difference was linear. The ratio of the heat loss of the insulated structure to that of the uninsulated structure was 62 per cent for an outdoor temperature of 0°F. and 66 per cent for an outdoor temperature of 32°F.

An attempt was made to heat the insulated house with six panels at an outdoor temperature of 0°F. using two panels in the living room and one each in the other four smaller rooms. Some of the rooms were found to be underheated because the heat loss of a particular room exceeded the installed capacity of that room. The results indicated the desirability of having heating units of lower and intermediate wattage capacity to heat small rooms.

The radiant panels in the uninsulated bungalow were compared under identical conditions with a forced warm-air heating system using baseboard registers whose vanes directed the warm air down at the floor. Comparison showed the radiant system provided more radiant energy at the 30-inch level and more comfort at the floor level.

The effect of lowering and raising the thermostat setting was studied for both temperature pickup and power

(*Continued on page* 280)

BALL BROS. ENTERS PLASTIC FIELD

Ball Brothers Company Incorporated, a firm known widely for its glass containers, metal, rubber, and paper products, has announced its entrance into a fifth and new field of manufacturing with the acquisition of a majority interest in Kent Plastics Corporation of Evansville, Ind.

Ball acquired its Kent interest in exchange for a substantial capital investment made in underwriting an expansion which the Evansville concern found necessary because of increasing demands for Kent products. Kent, organized in 1945, makes a broad line of functional and decorative parts for the automotive and home appliance industries and employs approximately 500 people.

The announcement followed the recent annual meeting of Kent stockholders at which five members of the Ball Brothers Board of Directors were voted into the membership of the Kent Board. All incumbent Kent officers and directors were re-elected.

New members of the Kent Board included Edmund F. Ball, President of Ball Brothers, Duncan C. Menzies, Ball Executive Vice President and General Manager, Alexander M. Bracken, Vice President and General Counsel, John W. Fisher, Vice President and Ball Director of Commercial Glass Container Sales, and George E. Myers, Vice President and Treasurer of the Ball system. Kent officers and directors renamed were Robert H. Morehouse, President, Lawrence H. Haase, Vice President, John H. Wall, Secretary, and Joseph F. Derr, Treasurer.

Presidents of the two companies said that there would be no change either in present management personnel or in the policies of the Kent management. The present management continues to represent a substantial ownership of Kent Corporation, with the Ball Company the only other stockholder.

1953 AMERICAN GLASSWARE JUBILEE

The 1953 American Glassware Jubilee, third annual nation-wide campaign to promote retail sales of moderately-priced glassware, will be staged this year the week of October 5 through 10.

The Glassware Institute of America, made up of the nation's nine leading manufacturers of table, kitchen, and cooking glassware, sponsors the yearly promotion which is designed to familiarize consumers with the versatility, quality, and good design in moderately-priced glassware.

A brochure containing full information on the Jubilee and on materials available is being prepared and may be obtained by writing to the Glassware Institute of America, Room 1508, 247 Park Avenue, New York 17, New York. The theme for the previous two promotions, "Glassware for Gracious Living," once again will be prominent in display and advertising material.

HOUZE OPENS WASHINGTON, D.C. OFFICE

The L. J. Houze Convex Glass Company has for the first time opened a sales office in Washington, D. C., it has been announced by E. V. Ogg, Executive Vice President. Sales operations in the nation's capital will be handled through the firm of Harbison and Masi, Inc.

The announcement of Washington sales representation coincided with a visit to the plant by principals of the Houze company, and a two-day meeting at the plant to canvass sales problems and the company's sales program involving technical glass, including the new atomic glass.

BOOK REVIEW

The Identification of Stones in Glass by Physical Methods

By H. E. Taylor and D. K. Hill

In their introduction, the authors thank "all the glass companies who have had the misfortune to supply them with material." In this case, these stones thrown in glasshouses have changed misfortune to good fortune. This book is the most useful to date on the subject. The scope is well chosen and the details are well presented. They reflect the authors' keeness of observation in their work in the Department of Glass Technology at the University of Sheffield. The index is accurate and complete. The style is good and errors are exceedingly rare. Rather few direct literature references are given, however. I recommend the book to all workers confronted with stones and cords in glass.

Most of the material in Chapters I, II, and IV on the Origin of Stones, Identification by Visual Methods, and Materials Found in Stones has already appeared scattered through the literature. The authors have added details from their experience and have organized all the information into a useful whole. Numerous excellent photographs are used, including some x-ray diffraction patterns. Crystallographic properties of stone materials are tabulated in the Appendices.

The immersion liquids listed in Table II are a rather elementary group aimed solely at differentiation between stone materials. No references to more extensive series are given. For accurate index measurements, they recommend the Leitz-Jelley Micro-Refractometer to check liquid mixtures which have been matched to the unknown stone material.

I believe the treatments in Chapters III and V, the Petrological Microscope and the X-ray Diffraction Technique, are inadequate for a work of this size. The section on "Crystal Group" seems a useful review for trained petrographers but not an adequate orientation for the inexperienced. Similarly, in Chapter V much more information is needed for the use of these techniques. Both chapters indicate how such methods can be useful. Also, they give interesting details of sample preparation. More details here would have completely rounded out an already very useful little book.

The Glass Delegacy of the University of Sheffield, Sheffield, England. 1952 i + 70 pp. 71 fig. 5⅝ x 8¾ in. Cloth.

G.B.B.A. VOTED TO CONTINUE TO REPRESENT OWENS-CORNING WORKERS

The Glass Bottle Blowers Association, A.F.L., defeated an attempted raid by the Textile Workers Union, C.I.O., by an overwhelming vote of 1394 out of 1874. The C.I.O. union received 411 votes and 58 votes were for no union.

The attempted raid was at the Owens-Corning Fiberglas Corporation's Newark, Ohio, plant, which was organized by the G.B.B.A. two years ago.

• Construction on new feldspar grinding facilities at Erwin, Tennessee, which will increase capacity for finely ground F-4 pottery grade flotation feldspar by about 50 per cent, has been announced by Norman J. Dunbeck, Vice President in charge of the Industrial Minerals Division of International Minerals & Chemical Corporation.

Current Statistical Position of Glass

Employment and payrolls: Due to a change in the breakdown of industries now being undertaken by the Department of Labor Statistics, figures for employment and payrolls in the glass industry will not appear this month. As soon as the Labor Department completes its reorganization of this data, these statistics will again be reported in THE GLASS INDUSTRY.

Glass container production, based on figures released by the Bureau of Census, was reported to be 10,696,973 gross during March 1953. Compared with February production of 9,000,228, a jump of 18.8 per cent is shown. During March 1952, glass container production was 9,399,715 gross, or 13.8 per cent below March this year. At the end of the first three months of 1953, production of glass containers has reached a total of 28,989,851 gross. This is 6.8 per cent ahead of the 27,123,226 gross produced during the corresponding period in 1952.

Shipments of glass containers during March 1953 spurted to 12,292,685 gross to establish a new all-time high for a single month. It is believed, however, that these unusually high shipments were brought about by the forthcoming price rise for glass containers effective April 1. Compared with February shipments of 8,670,985 gross, an increase of 41.7 per cent is shown. During March 1952, shipments were 9,214,138 gross, or 33.4 per cent under March this year. At the end of the first quarter of 1953, glass container manufacturers have shipped a total of 29,800,204 gross. This is 13.9 per cent ahead of the 26,154,347 gross shipped during the first quarter of 1952.

Stocks on hand at the end of March 1953 were 9,055,924 gross, a drop of 15.1 per cent from the 10,677,214 gross on hand at the end of February, and 11.3 per cent below the 10,215,726 gross on hand at the end of March 1952.

Due to a delay in the compilation of figures showing the production, shipment, and stocks of automatic tumbler ware and manufacturers' sales of machine-made table, kitchen, and household glassware for March 1953, THE GLASS INDUSTRY is unable to publish these statistics in this issue. It is planned to include these data in this department in the June 1953 issue.

GLASS CONTAINER SHIPMENTS

(All Figures in Gross)

	March, 1953
Narrow Neck Containers	
Foods	1,258,145
Medicinal & Health Supplies	1,584,705
Chemicals, Household & Industrial	905,650
Beverages, Returnable	687,771
Beverages, Non-returnable	130,195
Beer, Returnable	258,330
Beer, Non-returnable	622,015
Liquors	957,946
Wines	433,550
Toiletries & Cosmetics	730,095
Sub-total (Narrow)	7,568,402
Wide Mouth Containers	
Foods	*3,078,210
Dairy Products	302,329
Medicinal & Health Supplies	515,533
Chemicals, Household & Industrial	194,958
Toiletries & Cosmetics	190,236
Packers' Tumblers	231,827
Sub-total (Wide)	4,513,093
Total Domestic	12,081,495
Export Shipments	211,190
TOTAL SHIPMENTS	12,292,685

* This figure includes Home Canning.

GLASS CONTAINER PRODUCTION AND INVENTORY

(All Figures in Gross)

		Production March 1953	Stocks March 1953
Foods; Medicinal & Health Supplies; Chemicals, Household & Industrial; Toiletries and Cosmetics	Narrow Neck	3,783,099	2,965,661
	Wide Mouth	*3,629,907	*2,947,128
Dairy Products		266,134	311,306
Beverages, Returnable		774,469	1,041,271
Beverages, Non-returnable		114,099	171,948
Beer, Returnable		248,403	224,257
Beer, Non-returnable		581,873	371,347
Liquors		801,565	645,136
Wines		315,605	271,209
Packers' Tumblers		181,819	106,061
TOTAL		10,696,973	9,055,924

* This figure includes Home Canning.

COBALT ORDER AMENDED

The National Production Authority has amended its control order on cobalt to allow use of salts and compounds made from cobalt residues in glass colorizing, glass batch colors, glazing, and similar uses connected with the glass and glass container industries. Previously use of any cobalt substances for colorizing had been forbidden under Schedule 2 to M-80, an order designed to channel cobalt into prime defense uses.

The recent relaxation, issued April 30, was made possible by increases in imports of the residues. All cobalt materials must be imported, with most coming from British-controlled areas.

In making this relaxation, NPA hopes to encourage use of residual materials and so channel the prime metal into such work as jet airplane engines. The demand-supply situation in the blue metal is such that officials believe it will be necessary to continue cobalt controls in much their present form for many months to come. Previous editions of Schedule 2 to M-80 had permitted use of cobalt materials for glass decolorizing.

• Stauffer Chemical Company has announced the appointment of Archie E. Albright, Jr., as Assistant to the Executive Vice President, Hans Stauffer. Mr. Albright was formerly associated with the law firm of Patterson, Belknap and Webb, New York City.

• McDanel Refractory Porcelain Company has just completed a 4,000 sq. ft. addition to its Beaver Falls, Pa., plant to house a modern research laboratory.

New Equipment and Supplies

IMPROVED WEIGHT RECORDER

The Howe Scale Company, Rutland, Vermont, has announced the development of the new Howe Mechanoprint, a simplified and modern mechanical weight recorder, built-in as an integral part of the Howe Tape-Drive dial head. A simple touch of the push bar causes the weight to be printed. Printing can also be controlled by a trip switch on a conveyor line, on a monorail system, and by other methods.

The Mechanoprint is furnished with a variety of adaptations: for standard straight ticket, for ticket and tape, for odd-size tickets and with identifiers, manual or electric time and date stamp, consecutive numbering devices, etc. Its accuracy is guaranteed to 1/10 of 1% of the dial chart capacity.

MOLD RELEASE

Chemical Development Corporation, Danvers, Mass., has announced the development of a new mold release for polyester, epoxy, and phenolic resins. Called CD Mold Release B, the product is used on steel and other nonporous surfaces. It is effective for low-pressure glass-fiber laminating, as well as for compression or transfer molding.

CD Mold Release B is fast drying and is intended for production work. It is easy to handle and can be applied by spraying, brushing, or wiping with a cloth which has been saturated in the solution. It is long lasting and one application is said to last for many cycles.

SEMI-MICRO SPATULA

Fisher Scientific Company, 717 Forbes Street, Pittsburgh 19, Pa., has announced production of a semi-micro spatula especially designed for the semi-micro chemist.

One end of the 16-centimeter long spatula is tapered down to a 3.5-millimeter rounded tip to simplify the removal of precipitates from 5-milliliter conical centrifuge tubes. The other end is flattened to a slightly rounded 6.5-millimeter tip for work with the regular centrifuge tube.

Light in weight, but large enough to fit easily in the fingers, the new Semi-Micro Spatula is balanced to facilitate tremor-free transport of tiny grains of material from one container to another.

NEW ABRASIVE BLADES

Clipper Manufacturing Company, Suite 649, 2800 Warwick, Kansas City 8, Missouri, has perfected new abrasive blades that cut masonry materials with speeds approaching those of diamond blades.

The new blades will slice through a 2″ x 5″ Natco Furing Tile in only 11 seconds, through first quality dry press fire brick in 5 seconds, face brick in 8 seconds, and concrete brick in 17 seconds. Other features include: factory dressed cutting edge that assures peak cutting efficiency from the moment the blade first touches the material; protective blade blotters that lessen the possibility of fracturing from over-tightening the blade collar; steel blade centers that guard the saw shaft and strengthen the blade.

ELECTRONIC PYROMETER CONTROLLERS

The Bristol Company, Waterbury 20, Conn., has announced a new line of Free-Vane Electronic Pyrometer Controllers, suitable for actuating relays, electric contactors, solenoid valves, and motor valves to provide close temperature control of a wide variety of furnaces, ovens, kilns, salt pots, and other heating equipment.

The Free-Vane Controllers feature an electronic control system based on the frequency modulation principle, a newly-developed millivoltmeter mechanism, and unit plug-in construction. The basic model can be used for low-open, high-open, and low-high control.

CATALOGS RECEIVED

Linatex Corporation of America, Rockville, Conn., has issued a four-page folder featuring Linatex, a special form of natural rubber manufactured in Malaya.

Completely resistant to moisture, Linatex is from three to four times more resilient than other rubbers and is light in weight, having a special gravity of 0.97. The folder describes numerous applications of Linatex in industry, including its use in conveyor systems, tanks, fans, ducts, etc.

Minneapolis-Honeywell Regulator Company, Wayne and Windrim Avenues, Philadelphia 44, Pa., has issued several bulletins on industrial controls.

Catalog 8305 describes and illustrates non-indicating electric, electronic, and pneumatic controllers for temperature, pressure, and humidity, in addition to pneumatic and electric valves, switches, and relays.

Three new 4-page specification sheets describe and illustrate Brown ElectroniK recording potentiometers. Specification Sheet 160 covers circular chart recorders; Specification Sheets 164 and 165 cover single and multiple record strip chart recorders. Construction and engineering details are included.

Reeves Pulley Company, Columbus, Indiana, is distributing its new Bulletin V-532 describing the Reeves Flexi-Speed Drive, the latest addition to the firm's line of variable speed drives and controls.

In addition to showing the flexibility in mounting by means of photographs, the bulletin describes the unit in some detail, gives rating tables, shaft center distances, ordering instructions, and complete dimensions.

The Rapids-Standard Company, Inc., 342 Rapistan Building, Grand Rapids 2, Michigan, has published a new, four-page illustrated folder, Bulletin SJA-53, showing applications and features of the Rapistan Stevedore, Jr. portable belt conveyor. The two-color bulletin has photos and descriptions of typical uses and features of the unit, which is used in many types of industry for stacking, power boosting, and truck loading jobs.

The bulletin presents specifications and features of the Stevedore, Jr. in clear, easy-to-read chart and table form. Sketches and photos are used to show recommended installation procedures and to point out each part of the unit.

Selas Corporation of America, Philadelphia 34, Pa., has issued a new bulletin describing the Selas spear flame burner in the five sizes manufactured.

Of special interest are the full size illustrations of the burners and the flame length produced by them, together with BTU capacity, port area, and full dimensions. A list of various recommended industrial uses covers a wide range of applications.

Beckman Instruments Inc., South Pasadena 1, California, has issued Bulletin 303-250, an inclusive 28-page catalog of Beckman ultraviolet and visible spectrophotometers, picturing all sample cells and other accessories.

The two-color brochure contains detailed descriptions and illustrations of the Model B and DU Spectrophotometers, and such auxiliary units as the flame, reflectance, and fluorescence attachments are also described.

American Wheelabrator & Equipment Corporation, 1026 South Byrkit Street, Mishawaka, Indiana, has issued a new bulletin on wet blasting which discusses the performance of cleaning operations on glass molds without destroying close tolerances.

The bulletin shows how wet blasting is done, both during the manufacture of molds and during reconditioning maintenance to make important savings in both time and labor. Wet blasting during manufacture of a mold blends grinding lines, tool marks, and surface imperfections.

Fisher Scientific Company, 717 Forbes Street, Pittsburgh, has announced the availability of the new edition of the Manual of Laboratory Safety.

The 48-page, illustrated book has chapters on Accident Prevention, First Aid, Fire Prevention and Safety Equipment. A safety bibliography covering a wide range of fields is included, as well as a reproduction of the famous Laboratory Emergency Chart, which contains, in alphabetical order, rapid treatments for a comprehensive list of laboratory mishaps, both external and internal.

The trend is to **MONOFRAX®** FUSED CAST *refractories*

Typical port entrance. Note excellent fit of the MONOFRAX blocks.

PORT NECKS ARE VERY VULNERABLE
areas in present-day, long-campaign glass furnaces.
As other weak areas in tanks have been strengthened with fused cast refractories, it has become apparent that the port necks are often the first parts to give way. They have become one of the weakest spots in the tank. To balance these refractories with the rest of the tank and prevent costly hot-repairs, many operators are now using MONOFRAX fused cast refractories for the port neck sidewalls and crowns. These high-alumina refractories are inherently resistant to the erosive action of high-velocity flames, as well as to the extreme heat. They are chemically inert and don't tend to react with the batch dust. They have a lower spalling tendency which helps reduce or eliminate a possible cause of stones.

INDIANA — *A NEW RECORD*
for refractory life and tonnage production seems likely for an Indiana glass bottle tank. MONOFRAX fused cast refractories are used throughout the entire melting sidewalls, throat, doghouse and superstructure of this 36"-deep flint glass unit. On a recent shutdown for checker repairs, the MONOFRAX refractories were still in good condition after over two years of service —good enough to be left intact for another campaign. The operator anticipates obtaining at least another 12 months service before having to rebuild.

CARBORUNDUM
Registered Trade Mark
Dept. L-53, Refractories Division
The Carborundum Company, Perth Amboy, N. J.

O-I TO BUILD GLASS PLANT IN ATLANTA

Owens-Illinois Glass Company has announced that it has plans for constructing in Atlanta the largest glass plant in the Southeast.

The proposed plant would be located on an 80-acre tract in Fulton County, directly north and west of the intersection of Sylvan Road and the Central of Georgia Railroad, where the company is presently building a new warehouse equipped to store millions of glass containers.

J. P. Levis, Chairman of the Board of Owens-Illinois, said that no date had been set for the start of construction on the glass plant, but he characterized the warehouse as a first step toward centering in Atlanta production facilities capable of servicing the entire Southeast.

The factory, which would be No. 31 in a chain operated by Owens-Illinois in various parts of the country, would be equipped to make every variety of glass container.

The company's engineering department has completed preliminary plans for the factory which would employ between 800 and 1200 men and women when in full production. About 95 per cent of the employees would be drawn from the Atlanta area, Mr. Levis said. The planned factory would occupy a rectangular area 1500 feet along Sylvan Road and 460 feet deep.

R. F. WILEY NAMED LYNCH FACTORIES MANAGER

Announcement has been made of the appointment of Robert F. Wiley as General Factories Manager of the Glass Machinery Division of Lynch Corporation. In announcing Mr. Wiley's appointment, T. C. Werbe, Jr., Vice President & General Manager of the Division, stated that his duties would include supervision of production in the North Anderson and Marion, Indiana, plants of Lynch Corporation.

Mr. Wiley has been associated with the firm since 1946, being advanced to Assistant Chief Engineer of the Glass Machinery Division in 1948, and to Chief Engineer in 1951. Upon graduation from school, Mr. Wiley was employed by the Martin Machine Company for five years, and for five years with Wiley and Lett, Inc., where he served as Chief Engineer and Production Engineer until that firm was acquired by Lynch.

ZENITH OPTICAL APPOINTMENT

Aaron A. Levin has been appointed Director of Research and Development for the Zenith Optical Company, Division of Polan Industries Incorporated.

Dr. Levin was formerly with the Scientific Bureau of the Bausch & Lomb Optical Company as chief optical designer of microscopes, telescopes, and military, aircraft, and special instruments.

INTERNATIONAL GLASS CONGRESS PRELIMINARY PROGRAM

Papers to be presented before the International Glass Congress, scheduled to be held in Venice, Italy, June 28 through July 4, have been announced in a preliminary program being set up for the Congress.

Papers announced are: *A. Open Session:* M. Pasquato (Venice), "Venetian Glass," W. E. S. Turner (Sheffield), "Research and Research Centers Associated with the Glass Industry," M. von Czerny (Frankfurt), "Radiation Phenomena in Molten Glass." *B. July 1 and July 2 Sessions:* P. Angenot (Belgium), "Technique of Removal and Analysis of Inclusions in Glass," M. Brichard (Belgium), "New Process of Glass Melting by the Injection of Flames into the Melting Mass," M. Migeotte (Belgium), "Determination of the Coefficient of Expansion on the Chevenard," M. Migeotte and H. Vandecapelle (Belgium), "Influences of Stabilization on the Mechanical Properties at Elevated Temperature of Glass," A. Dietzel (Germany), "Potassium Calcium Nitrate Glasses" and "Influence of SO_3 on the Surface Tension of Glass," A. Smekal (Graz, Austria), "Fundamentals of Mechanical Strength Properties of Glass," W. M. Hampton (England), "Assessment of Tank Furnace Efficiency by the Formula Devised by the Society of Glass Technology," W. E. S. Turner (Sheffield), "Methods for the Determination of Temperature in Different Locations of a Tank Furnace System," I. Sawai and K. Takashi (Japan), "The Flow of Glass Through the Throat of a Bridge Wall Tank," M. Marchand (Belgium), "Thermal Balance of an Oil Fired Glass Furnace of 2000t Capacity," S. Kruzsewski (England), "The Application of New Techniques in Designing Furnaces," E. Barovier (Italy), "The Coloring of Glass Without Using Fused-On Metallic Oxides," W. E. S. Turner (Sheffield), "The Value of Modern Technical Methods in the Study of Ancient Glasses," R. Smith, "Some Observations on Glass of the Roman Period," and M. Le Pastor Bourquin (Switzerland), "P. L. Guinand."

W. F. WILSON ELECTED PRESIDENT OF ANCHOR CANADIAN SUBSIDIARY

Wm. V. Fisher, President of Anchor Hocking Glass Corporation, has just announced the election of W. F. Wilson as President of Anchor Cap & Closure Corporation of Canada, Limited, an Anchor Hocking subsidiary.

R. P. Herrold, an Anchor Hocking Vice President, was elected Chairman of the Board of the Canadian subsidiary, and H. E. W. Filmer, formerly Assistant Secretary and Assistant Treasurer, was elected Secretary. C. A. Geddes continues as Vice President, while E. H. G. Secker is Treasurer and Assistant Secretary.

Mr. Wilson succeeds J. O. Deegan, who recently died following a brief illness. Mr. Wilson joined Anchor Cap & Closure Corporation of Canada, Limited, as a salesman in 1928, was named Sales Manager and elected Vice President in 1946.

• Dr. G. H. Spencer-Strong, Chairman of the Porcelain Enamel Institute's Quality Development Committee and Vice President and Director of Research of Pemco Corporation, has announced that a new sub-committee of the Quality Development Committee has been appointed to prepare a standard test method for determining the alkali resistance of porcelain enamels.

Complete control for better glass-making—
from batch charger to forehearth

Brown glass tank control systems help to produce peak output of highest uniformity, through coordinated control of all critical phases of tank operation:

Level control: *ElectroniK* instruments regulate the charging machine to maintain constant level of glass in the tank.

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Tank temperatures: recording of roof, checkers, stack and flue temperatures with *ElectroniK* strip chart recorders provides a valuable guide to efficient tank operation.

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Supplementing these are accessory controls for fuel temperature, burner pressure . . . primary elements of all types . . . and full range of fuel and air control valves.

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MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4521 Wayne Ave., Philadelphia 44, Pa.

● **REFERENCE DATA:** write for Catalog 1530 . . . Instrumentation Data Sheets 1.4-1a and 1.4-2.

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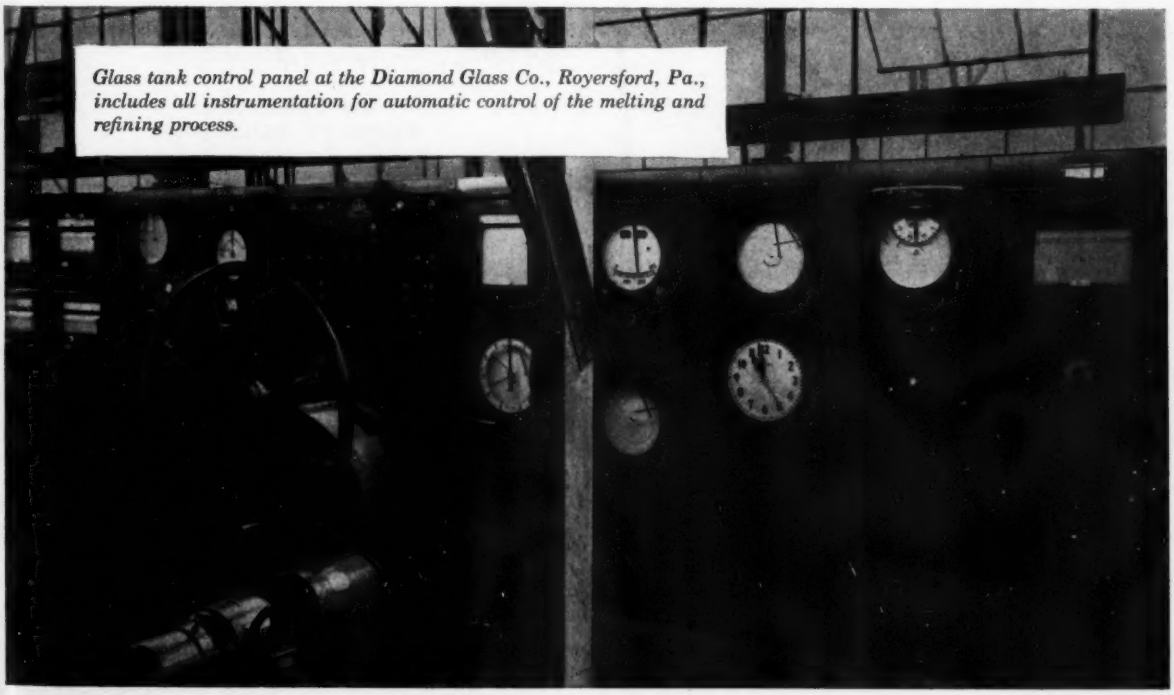

Glass tank control panel at the Diamond Glass Co., Royersford, Pa., includes all instrumentation for automatic control of the melting and refining process.

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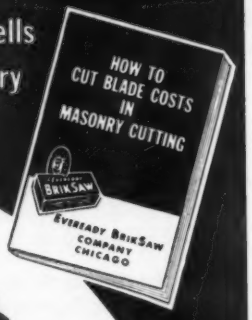
This FREE BOOK Tells How to Cut Any Masonry Material in SECONDS!



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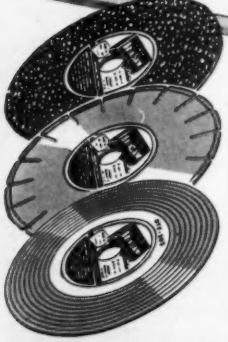
Get that FURNACE—KILN—OR BOILER back in operation fast! Cut **any** Fire Brick in **seconds** with a BRIKSAW . . . and "BRIKSAW CUT" Reline Jobs **last longer** — give more heats.



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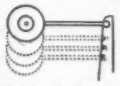
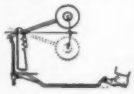


"Adjusta-Height" lets cutting head change elevation for materials of varying thickness . . . adjusts in 4 seconds.

Swing the cutting head to any desired position with this "Toe-Matic" foot treadle. Fast shift from one type of masonry material to another.



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One-piece cutting head for immediate, easy portability. Off the saw frame in 21 seconds flat!

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No. EI-14

Carl U. Fauster, right, Advertising Manager of Libbey Glass, division of Owens-Illinois Glass Company, admires the 1952 Award of Merit won by Libbey in the annual competition held by the Associated Business Publications. It is the fifth award in seven years that Libbey has received for effective use of advertising in merchandising publications. At left is William A. Perry, III, of J. Walter Thompson Company, Libbey's agency.

GLASS CONTAINER COMPANIES AND UNION MAKE WAGE AGREEMENT

A wage-reopening conference between representatives of the glass container industry and the Glass Bottle Blowers Association, AFL, has resulted in an agreement on a wage increase of 4% plus a flat increase of 4½¢ per hour. for a total in excess of 10¢ per hour. The announcement was made by Lee W. Minton, President of the union, and Ralph Lind, Secretary of the Glass Container Manufacturers Institute Labor Committee. A committee of fifty union members and a like number representing twenty-seven leading glass manufacturers worked out the agreement after five days of negotiations.

The new agreement covers only machine operators, upkeep men, and apprentices. There has been no nationwide strike in the industry since 1886.

O-I PUBLISHES PRODUCT DIRECTORY

Because of the similarity of the names of the three glass companies in Toledo, Owens-Illinois Glass Company has published a booklet, "A Directory of Owens-Illinois Glass Company Products."

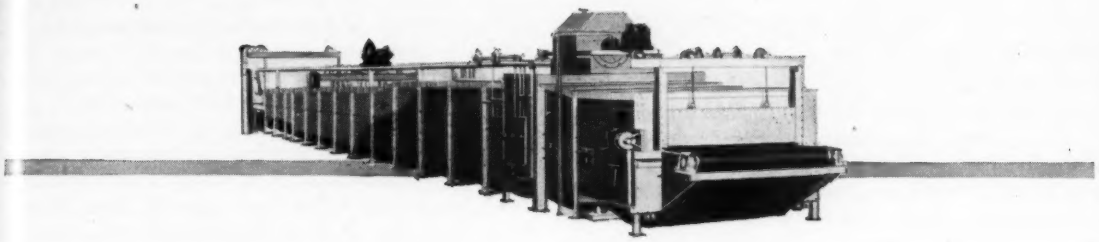
The booklet, compiled as a means of identifying the products of Owens-Illinois, describes and illustrates representative glass and non-glass products produced by the firm's various operating units.

• The first in a series of Traveling Clinics on material handling has been scheduled to convene June 10 at the Hotel Statler in New York City. The purpose of the Traveling Clinics is to develop among users a better understanding of the correct application of material handling equipment to industry's most pressing problems.

ERRATA: In the April 1953 issue of The Glass Industry, Page 220, in the fourth line under the paragraph headed Summary, the line should read "stones from known sources whenever possible" rather than "stones from unknown sources whenever possible."

experience

...A PRICELESS HERITAGE!



EXPERIENCE is the mother of wisdom . . . a builder of confidence . . . a forerunner of even greater things to come.

For more than three decades, Surface Combustion Corporation has been adding to its already vast knowledge of the Glass Industry. The close association which has developed throughout the years has become a valuable asset in building confidence in and the acceptance of its products.

It must be acknowledged, however, that developments of the past serve as guideposts for the future. Here at Surface Combustion, we are not content to rest on our laurels. We are constantly striving to build a better lehr . . . combustion system . . . conveyor mechanism . . . control apparatus . . . by keeping abreast of current conditions . . . by attempting to anticipate the future in an Industry where mistakes are too costly to be tolerated.

Look to Surface Combustion Corporation, with its unparalleled experience, to continue making vital contributions to the Glass Industry.

Continuous Glass Annealing Lehrs for every kind of glass • Continuous Convexing and Bending Furnaces • Continuous Decorating and Reannealing Lehrs • Continuous Conveyor Type Pottery Decorating Kilns • Special Processing Furnaces • Mould Heating Ovens Recuperative Glass Melting Tanks • Consulting Engineering Service on All Heating Operations.

Surface Combustion **CORPORATION**

TOLEDO 1, OHIO

CONTROL OF COLOR . . .

(*Continued from page* 254)

ing agent in the internal balance of an amber glass batch acts as a buffer against variations in reducing level.

(3) Moisture or water of hydration. Water added to batch or water of hydration in raw materials will tend to lighten color. Water apparently tends to hasten the oxidation of sulfur according to the following equations:

#3—$2\ NaFeS_2 + 3\ H_2O \longrightarrow Na_2O + 3\ H_2S \uparrow + 2\ FeO + S$

#4—$FeS + H_2O \longrightarrow FeO + H_2S \uparrow$

(4) FeO, Fe_2O_3, Fe_3O_4. Discussed under (3) color darkeners.

(5) Furnace Pull. Also discussed under (6) color darkeners.

(6) Clean wet plant cullet. Super clean wet plant cullet tends to be oxidizing due to moisture present and to the diluent effect upon amount of sulfur originally present in the batch. Purchased cullet, on the other hand, even though labeled as washed, usually is reducing to a certain extent. Definite cullet ratios should be maintained in the batch with the use of both types controlled as you would any other raw material.

Summary

An attempt has been made to present the practical side of amber color formation and control. Control of intensity of amber color is simply a study of the oxidation-reduction influences a given batch is subjected to during the melting processes.

For the most part, control of color centers around sulfur retention and formation into sulphide groupings. Base composition plays an important role in determining degree of sulphide retention but, for routine control of a given composition, the degree of oxidation or reduction controls the color produced. These factors have their origins in operation, internal balance of batch, and raw materials.

Stability and tints of color to be expected from any given amber glass are closely associated with amount of iron and the valence of the iron in the glass structure. In general it can be said that the lower the iron, the redder the color. An excess of reduced iron results in brownish tints; an excess of oxidized iron results in greenish tints. Instability of low iron amber glasses results from enforced longer sulfur chain formation.

To produce stable commercial amber glasses having transmissions between 30 to 50% measured at 550 Mμ, iron or manganese or a combination of the two must be present in excess of the amount required to form the sulphide grouping. Lighter shades of amber color are not as critical because amount of sulphide sulfur present is relatively small and amount of iron originally present is sufficient without any additions being necessary.

Considering the large volume of amber glass produced compared with the low volume of knowledge about the coloring mechanism, it is a subject needing additional study. It is hoped that these practical plant interpretations might help to stimulate this work and aid in more uniform color control.

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A.C.S. NORTHERN OHIO SECTION ACTIVITIES

The Northern Ohio Section of the American Ceramic Society, at its recent meeting, included a guided tour of Ferro Enamel Corporation's manufacturing plant, inspection of the new research laboratories, and the election of officers for 1953.

The officers and committee chairman for the 1953 term are: *Counselor,* W. F. Creson; *Chairman,* G. K. Lowe; *Vice Chairman,* R. E. Skinner; *Treasurer,* J. J. Gangler; *Secretary,* W. A. Graff; *Membership,* F. F. Newark; *Program,* J. Lockridge; *Publicity,* E. L. Woodall. The physical and chemical application of the spectrophotometer and interferometer were discussed by Gordon Johnson of Ferro's Research Division.

At the May meeting of the Section, Dr. H. B. Vincent of Kimble Glass Company gave a talk entitled "The All-Glass Television Tube." Dr. Vincent used slides and motion pictures to illustrate his talk.

• Dr. John A. Hipple, Chief of the Atomic Physics Section of the National Bureau of Standards, has been named Director of the Mineral Industries Experiment Station, succeeding Dr. A. W. Gauger, who has retired with emeritus rank.

KIMBLE MAKES ANNUAL HEALTH AWARD

A silver plaque, which goes with winning the $500 annual Kimble Glass Methodology Research Award, was presented to Ad Harris at a meeting of the Executive Committee of the Conference of State and Provincial Public Health Laboratory Directors held in Atlanta, Georgia.

The award was instituted by Kimble Glass, an Owens-Illinois Glass Company subsidiary, "to give public recognition and financial reward to an individual who has contributed outstandingly to developing a new or better method of procedure in the field of public health." Mr. Harris and his staff received the award for the development of tests for syphilis, which are now used in many state public health laboratories and clinics.

KAISER NAMES DIRECTOR OF REFRACTORY RESEARCH

James C. Hicks has been appointed Director of Refractory Research for Kaiser Aluminum & Chemical Corporation, to succeed the late Leslie W. Austin.

During the past ten years with the firm, Mr. Hicks has been intimately associated with the development of the company's refractory products for basic industry, and for eight years was assistant to Mr. Austin.

RUSSIAN TRANSLATIONS . . .
(*Continued from page* 262)

streams is between 25 and 30°. The resultant of the two momentums should form a small angle with the horizontal. In Fig. 2 this angle is 4°. This figure is the section of a burner built according to the above reasoning. All the linear measures in the figures are millimeters. If the flame drops too much toward the glass surface, the glass is contaminated.

The burners should be as wide as compatible with the two requirements: (a) it must be possible to control the temperature variation along the furnace by adjusting the burner width, and (b) the distance between the burners should be large enough to allow the necessary manipulations. About 40% of the melt surface should be covered with flame.

If sodium sulfate is used in the batch, the atmosphere in the melting end must be reducing, and in the fining end oxidizing. This can be achieved by increasing the length of the mixing chambers in the fining end.

Barium oxide acts as an oxidizer as air transforms it at 500° into barium peroxide which, at higher temperatures, oxidizes FeO to Fe_2O_3. Analogously, As_2O_3 is oxidized to As_2O_5 which decomposes at higher temperatures.

As the table demonstrates, oxidizers improve the light transmission of glass. The recommended additions to the batch are 0.2% As, or 1% BaO, or 1% (BaO + As), or 0.5% Sb_2O_3.

• J. S. Algeo, W. W. Holloway, and L. C. Paull were re-elected Directors of the Hazel-Atlas Glass Company.

SILICATE CHEMISTRY INSTITUTE APPOINTMENTS

Two appointments to the staff of the Institute of Silicate Chemistry and Related Sciences at the University of Toledo have been announced by the Board of Directors.

Dr. Wingate A. Lambertson, now a member of the Argonne National Laboratory staff, has been named Professor and Research Associate to Director Dr. Wilhelm Eitel. Arthur H. Black, Assistant Professor of Chemistry, was named Assistant to the Director.

Dr. Lambertson, the author of a number of technical publications, has been engaged in basic research of ceramic materials for nuclear reactors. Mr. Black received bachelor and master of science degrees from the University of Toledo and is continuing his graduate work at the University of Michigan.

GLASS FIBERS ANNUAL STOCKHOLDER MEETING

The annual shareholders meeting of Glass Fibers, Inc. was presided over by R. H. Barnard, President.

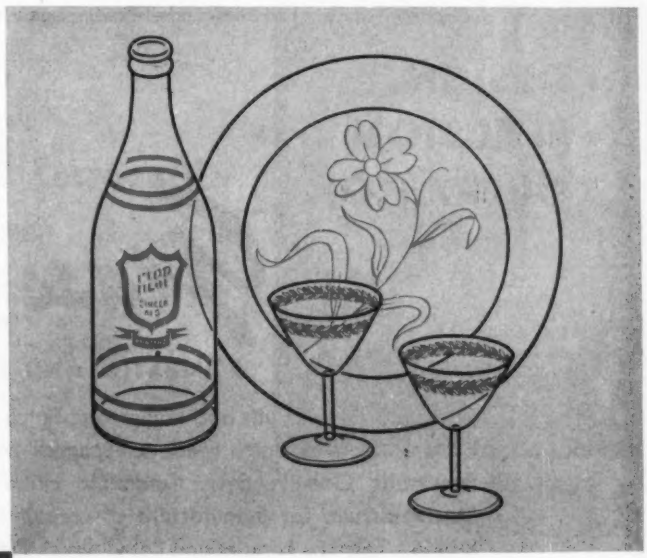
The following directors were re-elected at the meeting by the stockholders: Chairman, Gordon W. Reed, New York, N. Y.; Randolph H. Barnard, Toledo, Ohio; John M. Foster, Marion, Indiana; D. Dean McCormick, Chicago, Illinois; Harry O. King, New York, N. Y.

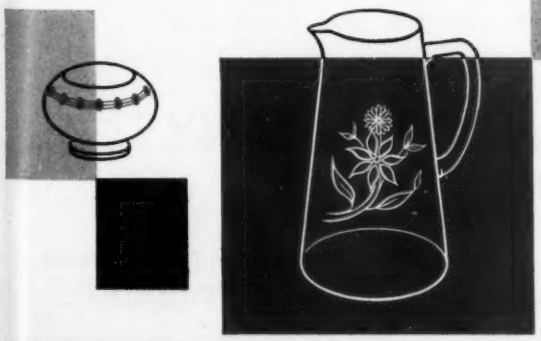
Stockholders also voted in favor of a resolution authorizing an increase in the number of directors of the company from five to nine members. Mr. Barnard announced the election by the Board of Directors of M. Dean Worcester as Vice President of the firm in charge of the Aero-Coustic Division at Burbank, California.

DuPont Glass Colors

FOR UNIFORMITY
AND EASE OF APPLICATION

THERE'S a complete line of Du Pont glass colors for your decorating needs. Each of these durable colors is produced against a permanent standard . . . assures maximum coverage over a wide firing range. You can be sure of uniformity and sparkling appeal with all Du Pont colors . . . and, as always, Du Pont technical men will be glad to give you prompt assistance. E. I. du Pont de Nemours & Co. (Inc.), Electrochemicals Dept., Wilmington 98, Del.





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DU PONT

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

DU PONT GLASS COLORS

HOUZE DECORATING . . .

(*Continued from page* 257)

pattern is submitted to the mold department where it is produced in cast iron and then machined to fit the spindles of a special type of lehr equipment; (5) The Decorating Department takes the already made glass (cased opal, colored sheet drawn, or whatever the case) cuts sample squares or other interesting contours, and applies the design by any of the aforementioned decorative processes; (6) It enters a specially designed firing kiln, passes along under an intense natural gas flame which is hot enough to soften the glass sufficiently so that it bends and takes the shape of the mold, while simultaneously fusing the design permanently onto the glass.

Decal designs are applied in two slightly different ways. Decals are either the varnish type, or the slide-off type. The former are made especially for the pottery and dinnerware fields and consist of a multiple color design on a layer of special varnish, with a paper backing. A brush is dipped into a container of special varnish and the glass is coated very thinly but uniformly. It is allowed to become tacky; then a second girl applies the design itself, after having first dipped the decal in water so the paper floats off. The plaque or tray is then sponged dry, put into a rack, and allowed to air dry. If a silk screen design is also to be put on the item, as in the case of the automobile trays, shown in Fig. 1, the silk screen application is made the following day. Fig. 2 shows a silk screen border being put on a glass square to which the automobile decal has already been affixed. In this case, only one color is involved, dark green, so a silk screen is made of the border design. The girl mixes the color on a glass slab; she applies the ceramic material by a rubber squeegie which is rubbed over the silk screen stencil; after lifting up the silk screen rack, only the design remains on the glass square. It is then introduced into the lehr.

If the design calls for several colors, as did the Christmas card, a separate silk screen is made for each color—in this case green, yellow, red, and black. Four separate stations are set up and the squares are passed from one girl to the other for each color application, after which they go into the bending equipment. Where a number of colors are involved, the ceramic paste is heated and applied on a heated screen whereby instant drying occurs. This results in greater production.

The slide-off type of decal is only slightly different than the varnish type. The decal is dipped in water until the film with the design on it slides off. It is then put on the glass, sponged and squeegeed dry, allowed to air dry, and then put into the kiln. As it passes through, the thin film dissolves from the firing leaving the design permanently fired on the surface of the glass.

Fig. 3 shows two methods of hand application of design: paint brush and air brush. The artist is hand painting a design on a pressed-ware cigarette dish which cannot take a silk screen impression or decal. On the work desk, on the right hand side, is a similar container on which he has sprayed a pattern with gold pigment.

Photographs are applied by way of the decalcomania method and there are three types: one color, such as sepia, grey, green; another providing two colors, such as

• DESIGN
• ERECTION
• OPERATION

of Glass Plants

DOMESTIC AND FOREIGN

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blue and grey; and a four-color decal. In the first two, glossy photographs are converted into decals by a company specializing in this work, and the decals are applied by the varnish method exactly as described earlier. For the third method, however, it is necessary to make four copper plates, one for each primary color and one for black. They are then applied in a decal form after conversion.

In the firing of the decorated pieces, molds are set up on a continually moving chain of spindles. The line enters the bending lehr on the left (as shown in Fig. 4), moves slowly inside until it passes the firing line; the glass softens and drops to the contours of the mold; by the time the glass emerges at the exit, it is just about cool enough to handle. But it is removed by a special suction grab (shown in the photo), lined up for final cooling, inspection, and packing.

There is no limit to the shapes, sizes, and types of decorative ware that can be turned out. Imagination is the only restrictive agent. Already, Houze has reached the stage where they are making cased opal glass and pressed forms only for this department. The company is also adding a ground and polished line and sandblast-decorated line of trays, vases, fruit dishes, etc., not shown in these photographs. This is one gift horse Houze is going to lead in the right direction.

• The New York City domestic sales offices of the Abrasive, Grinding Machine and Refractories Divisions of Norton Company, formerly of 61 Broadway, have moved to Green and North Street, Teterboro, New Jersey.

REFRACTORIES INSTITUTE PUBLISHES MANUAL ON PALLETIZING

A manual on "Recommended Equipment and Procedure for the Palletized Loading and Shipment of Refractory Brick" has just been released by The Refractories Institute.

The manual, containing 28 pages of scale drawings and descriptive material, covers: the standard wooden pallet, standard pallet load protection, carloading patterns, and standard wooden end and side gates.

A special committee of the Institute has studied all aspects of this problem for over a year. A wide variety of palletizing practices were examined and the advantages and disadvantages of each were carefully analyzed. Consumer and transportation associations were consulted. The manual now being offered represents a detailed formula for the palletized handling of refractories which can be followed readily by all shippers.

Copies of the palletizing manual may be secured from The Refractories Institute, 1801 First National Bank Building, Pittsburgh 22, Pa.

BROCKWAY APPOINTMENT

The appointment of Jack E. Irwin as Manager of the Prescription Ware Division has been announced by Brockway Glass Company. Mr. Irwin was formerly associated with the A. T. McClure Glass Company and has had wide experience in the sales field.

Other recent additions to the Sales Department are Raymond C. Price, who will be located in Pittsburgh; Kenneth Shobert in Buffalo; Lester T. Radcliff in the Cleveland-Detroit area; and Emery Grant in Kansas City.

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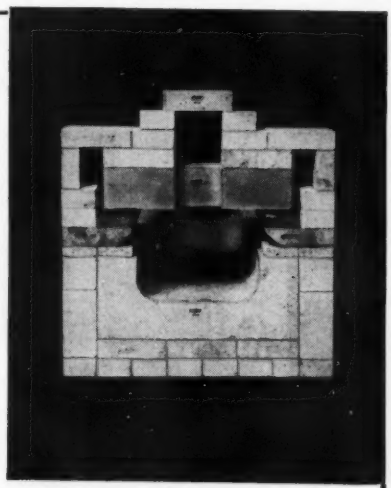

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Gold Bond
INDUSTRIAL PRODUCTS

RESEARCH DIGEST . . .

(*Continued from page 267*)

demands. From the data accumulated it appears that in the insulated house, utilizing all ten panels, one hour is required to raise the room temperatures from 65° to 80°F. at an outside temperature of 0°F.

Analysis of the tests indicated that compensated room thermostats with very low differential which produce rapid cycling of the heating units are desirable with radiant glass heating panels. This would provide a continuous emission of radiant heat, since the cessation of radiation between heating cycles was quite noticeable when the "off" period was of long duration. Also a control device for the system which would permit heating of the house to a comfortable level at design outdoor temperature, but which would limit the electric power demand to a value approximated equivalent to the design heat loss rate, is desirable both from the standpoint of the consumer and the utility company.

One type of glass panel was subjected to thermal shock tests of the type that might occur in use, such as rain coming through a window or shower spray in the bathroom. The main effect of the treatment was an increase in power demanded by the panel due to the water's cooling action. Mechanical shock tests showed that the principal weakness was in resistance to shock around the edges.

The results of these tests indicate that electrically heated radiant glass panels constitute a satisfacory method of warming a well insulated basementless house from the standpoint of temperature gradients in the vertical and horizontal directions, floor temperatures, and general comfort. Accepted methods for the calculation of the heat loss of a house may be used in determining the total capacity of the heating units required. The total energy required to produce a desired condition of warmth may be slightly less with electric panels than with more conventional heating units because of the absence of piping or duct heat losses, because the reverse heat losses from the heating elements are lower, and because the individual room thermostats can more readily prevent overheating of any of the rooms.

BABCOCK & WILCOX NAMES REFRACTORIES MANAGER

J. E. Brinckerhoff, formerly Sales Manager of the Refractories Division of The Babcock & Wilcox Company, has been named General Manager of that division, according to A. M. Kohler, Vice President of the company.

At the same time, Mr. Kohler announced other changes in the division as follows: C. L. Norton, Jr., formerly Technical Director, will become executive assistant in charge of all development and engineering activities; Carl Claus, formerly superintendent of the Augusta works, will become executive assistant in charge of all sales and manufacturing operations; J. D. McCullough will continue as chief engineer in charge of engineering, service, and application, with additional duties; Mark J. Terman, formerly district manager of the Pittsburgh office, will become Sales Manager; Bradford Hooper, who has been assistant to Mr. Norton, will become Technical Director; and Royce K. Mack, formerly assistant to Mr. Claus, will become superintendent of the Augusta works.

INVENTIONS AND INVENTORS . . .
(Continued from page 266)

lever under tension of spring 50 (not shown) and stretches the fluid glass and in so doing it removes the tip end of the ampul. When the glass becomes softened and the tip is raised by the removal mechanism, a very fine capillary tube of molten glass is drawn out and forms a connection between the wastage and the ampul. It is necessary to melt this capillary tube to complete the seal, and, therefore, the ampul being sealed must be held in the flame a sufficient length of time for this thread-like tube to melt off. The complete sealing becomes fully automatic.

The patent contains eight claims and the reference cited was as follows: 2,270,152, Themak, Jan. 13, 1942.

Glass Tube Cutter, Fig. 10. Patent No. 2,631,411. Filed July 10, 1951. Issued March 17, 1953. One sheet of drawings. Louis A. Pierson.

A useful device for cutting glass tubes or ampuls that have been hermetically sealed is shown in Fig. 10. In operation, the tool 10 may be held in one hand with the jaw ends 34 and 28 just far enough apart to permit the suture tube 33 to be placed between and against the anvil jaw. The knurled nut 27 is then tightened abutting against the back of anvil lever 11 until the cutter wheel 37 has been brought against the side of the suture tube 33 to apply just the proper amount of pressure. Holding the tube 33 in one hand and the tool 10 in the other hand, the tube and the tool are rotated relative to each other to abrade a complete circle about the tube whereupon the tube may readily be broken along the abraded cutter line thus provided without danger of contaminating the contents of the tube or of the ampul and without danger of cutting one's fingers.

The patent contains two claims and the following references were cited: 454,233, Smith, June 16, 1891; 467,500, Fenwick, Jan. 26, 1892; 499,933, Phillips, June 20, 1893; 1,584,572, FozBello, May 11, 1926; 1,634,323, Fletcher, July 5, 1927; 2,425,093, Fosler, Aug. 5, 1947; and 2,447,988, Pierson, Aug. 24, 1948.

Zinc-Magnesium Oxide Luminescent Materials. Patent No. 2,628,201. Filed July 29, 1949. Issued February 10, 1953. One sheet of drawings (none reproduced). Assigned to Radio Corporation of America by Arthur L. J. Smith.

This invention provides an improved phosphor material which has all of the desirable properties of zinc oxide phosphors but has a peak emission which may be shifted to about 4800 A° if desired. It also possesses a relatively high efficiency of output in the ultraviolet region of the spectrum.

The luminescent material is prepared by mixing zinc oxide and magnesium oxide in which the proportion by weight of magnesium oxide is 1-50 mol per cent. The mixture is then fired at a temperature of 907°C. to 1300°C. in a reducing atmosphere and cooled in a non-oxidizing atmosphere.

The patent contains 11 claims and the references cited were: 2,028,980, Korinth, Jan. 28, 1936; 2,481,344, Reimert, Sept. 6, 1949; and 2,544,236, Reimert, Mar. 6, 1951.

(Continued on next page)

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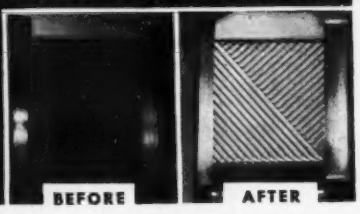

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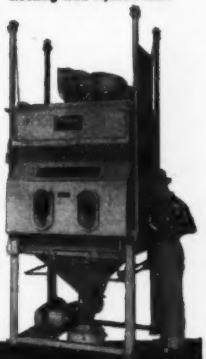
Actual unretouched photos of mold before and after cleaning with Hydro-Finish



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Miscellaneous Processes

Etching Glass Block Molds. Patent No. 2,621,114. Filed September 15, 1950. Issued December 9, 1952. No drawings. Assigned to Pittsburgh Corning Corporation by Ralph A. Johnson.

The art of etching patterns on the face plates of bronze molds used in the manufacture of glass building blocks is improved by the following procedure:

"The method of deep etching border patterns upon machined pattern faces of bronze glass block molds, which consists of coating the machined faces with a continuous asphaltum masking coat, stippling the desired pattern of a masking coat upon the borders, immersing the mold with the boarder pattern face down in a concentrated ferric chloride solution, continuously suspending the mold above the bottom of the solution container for 2 to 3 hours, removing the mold and washing in clear water before removing the masking coats."

The patent contains three claims and the following references were cited: 1,313,233, Grass, Aug. 12, 1919 and 2,026,603, Zarse, Jan. 7, 1936.

Window for Cathode-ray Tube. Patent No. 2,617,953. Filed June 28, 1949. Issued November 11, 1952. Three sheets of drawings, none reproduced. Assigned to Electronized Chemicals Corporation by Arno Brasch.

The details of window construction for a cathode-ray tube are given. Such tubes employing corpuscular radiation are used for many industrial purposes, such as the sterilization of perishable foods. Such impulse type discharge devices develop quite large peak currents (100,000 amperes) and great mechanical and electrical strains are exerted upon the receiving parts, especially the exit or window parts demanding replacement and reconstruction of the vacuum.

An auxiliary window structure is provided that will stand severe electric and thermic stresses and at the same time permit radiation to be applied to as large an area as possible with sufficient penetration and even distribution. The windows are also quickly replaced without substantially interrupting the flow of production.

The patent contains three claims and 16 references were cited.

Sunglasses. Patent No. 2,628,352. Filed March 6, 1951. Issued February 17, 1953. Three sheets of drawings (none reproduced). Paul Astruck.

This invention provides sunglasses for the eyes in which the eye-pieces are hinged to the mounted frame. The eye-pieces are transparent colored material and are flexed to allow their being engaged with lugs on the frame. In this manner the eye-pieces can be moved at various upward angles in front of the eyes to provide the desired and comfortable protection.

The patent contains three claims and the references cited were: 1,685,725, Rowe, Sept. 25, 1928; 2,510,539, Arbenz, June 6, 1950; and 452,266, Great Britain, Aug. 19, 1936.

• William P. Hemphill has retired from the Board of Directors of Laclede-Christy Company. Elected to take his place is Herbert F. Boettler, Vice President of the First National Bank in St. Louis.

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STRESS-OPTICAL COEFFICIENT . . .
(*Continued from page* 259)

we obtain:

$$c = 21.33 \frac{\Delta y}{\Delta w}.$$

The difference between each mean extinction position and every other mean extinction position was then used to make separate calculations of the stress-optical coefficient. Fifteen such calculations were made, and the average of these was found to be 2.62 brewsters.

The data were examined for errors, and the probable error of the mean was found to be ±.01 brewsters. Therefore, from the data of this investigation, the stress-optical coefficient of the plate glass studied may be expressed as, 2.62 ±.01 brewsters.

Acknowledgments

This investigation was undertaken under the direction of Dr. Howard R. Swift and Dr. Donald E. Sharp of the Libbey-Owens-Ford Glass Company, and the work was conducted at the University of Toledo. The writer greatly appreciates the help of the directors, and would also like to extend thanks to Professor Walter V. Burg, and Mr. Albert Sparks of the University of Toledo for their co-operation in this task.

REFERENCES

1. G. Friedel, *Bull. Soc. Min. France* 16, 19-33 (1893). Taken from Goranson and Adams, loc. cit.
2. R. W. Goranson and L. H. Adams, "A Method for the Precise Measurement of Optical Path Difference Especially in Stressed Glass". *Jour. Frank. Inst.* 216 (4) 475-504 (1933).
3. R. A. Houston, A Treatise on Light, p. 205. Longmans, Green and Co., Ltd., London, New York, 1915. 528 pp.
4. Francis A. Jenkins and Harvey E. White, Fundamentals of Physical Optics, pp. 329-330. McGraw-Hill Book Co., Inc., New York and London, 1937. 435 pp.

NEW FIBERGLAS INSULATING PRODUCT

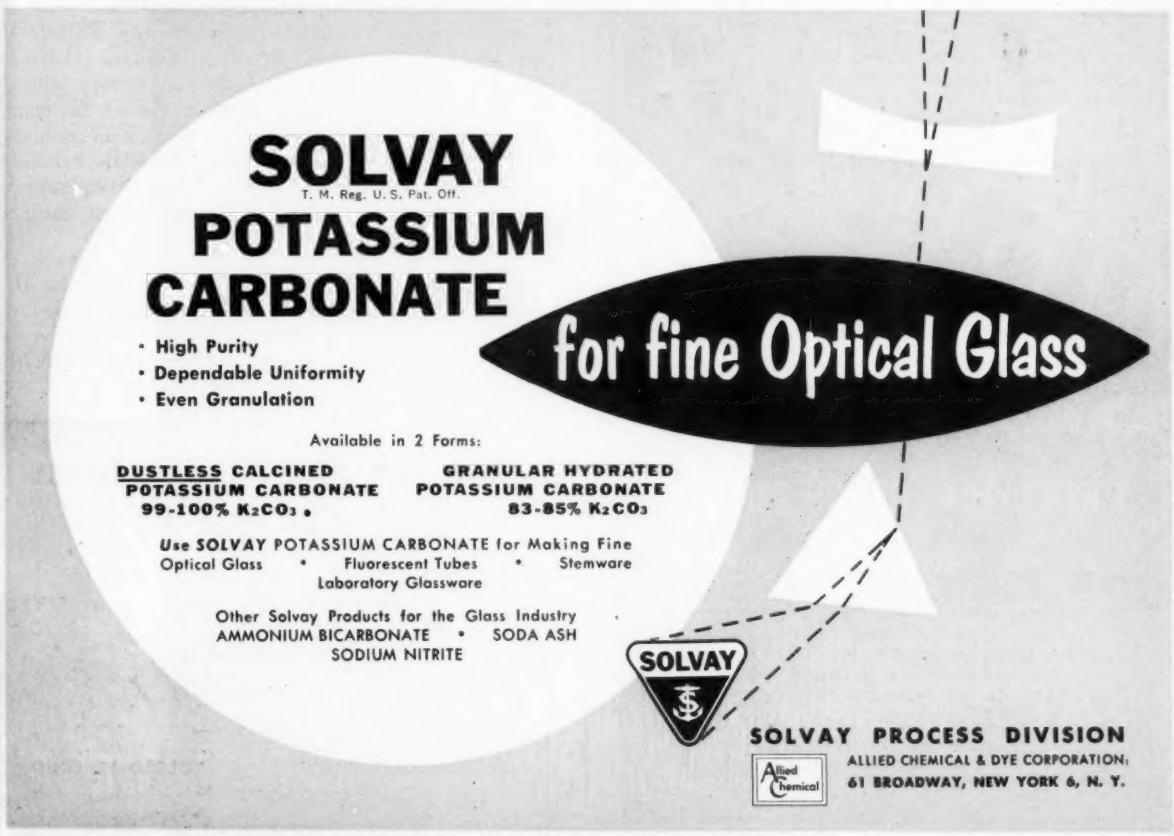
A new Fiberglas insulating product for lining the interior of air conditioning or warm air ducts has been introduced by Owens-Corning Fiberglas Corporation. Known as Flexible Duct Liner, the insulation has a high noise reduction efficiency and thus effectively reduces sounds that normally travel through air ducts.

The new product has excellent thermal insulating properties and when used inside of ducts allows the metal surface to act as a vapor barrier, thus preventing condensation on those ducts carrying cool air through areas of high humidity.

A. P. GREEN TRAFFIC MANAGER RETIRES

L. M. Wallace, who is retiring as General Traffic Manager of the A. P. Green Fire Brick Company, was recently honored at a testimonial dinner attended by many of his friends from the railroads and Traffic Club of St. Louis, as well as company officials. Mr. Wallace retires after thirty-four years of continuous service with the company.

Upon graduating from high school, Mr. Wallace worked as an apprentice to a traffic manager. He became a freight traffic counselor, and A. P. Green Fire Brick Company was his first client. Later he was made Traffic Manager of that company.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CORNING APPOINTMENTS

Five major appointments in Corning Glass Works and the establishment of a new operating division in the company have been announced.

Three new officers, John L. Hanigan, Frederick H. Knight, and Henry H. Sayles, were elected Vice President, Secretary, and Assistant Secretary, respectively. Thomas Waaland was appointed Director of Industrial Relations and Dr. John F. G. Hicks was made General Manager of the newly-formed International Division of Corning Glass Works. The International Division will consolidate under one head all foreign activities of the company, including export sales, foreign licenses, exploration of new overseas markets, and relations with the firm's foreign subsidiaries and associates.

Mr. Hanigan joined Corning in 1937 and advanced through various manufacturing departments and plants of the company. He continues as General Manager of the Electrical Products Division, a post he has held since 1951.

Mr. Knight succeeds W. H. Curtiss, who continues as a Director of the company and President of The Corning Museum of Glass. Mr. Knight has been with the company for 16 years and is a former Manager of its Patent Department. He was named Assistant Secretary in 1945.

Mr. Sayles, Assistant Secretary, practiced law as a partner in the firm of Sayles and Evans before joining Corning's legal department in 1951.

Mr. Waaland succeeds Harry M. Hosier in the post of Director of Industrial Relations. Mr. Hosier, a Vice President of Corning Glass Works, was named Industrial Relations Adviser. Mr. Waaland became associated with Corning in 1942. Four years later he was made Assistant Treasurer and in 1950 became Manager of Industrial Relations.

Dr. Hicks, General Manager of the International Division, joined Corning's laboratory staff in 1938. For the past six years, he has been Director of Foreign Technical Service and has been closely connected with the operations of Corning's associated companies in Latin America and Europe.

PENNSALT NAMES GENERAL SALES MANAGER

Albert H. Clem has been appointed General Sales Manager of the Pennsylvania Salt Manufacturing Company, filling the post left vacant by the recent death of Russell S. Roeller.

Before this appointment, Mr. Clem was Assistant General Sales Manager. He joined Pennsalt in 1938 following his graduation from the Pennsylvania State College with the degree of Bachelor of Science in Chemical Engineering. Starting in the Development Department of the Research and Development Division, he was subsequently a technical sales representative in the Detroit area for the Metal Processing Department, and later, in the same department in Philadelphia, a Product Supervisor, Assistant Sales Manager, and Sales Manager. He was later assistant to the Vice President-Sales, Sales Manager of the Industrial Chemicals Department, and Field Sales Manager in charge of all district sales offices.

NORTON UNVEILS NEW GRINDING MACHINE PLANT

Norton Company has shown publicly its new $6,000,000 expansion of its Grinding Machine Division. The new plant consists of a 740-foot by 300-foot factory joining a 360-foot by 100-foot office building. Among the many features of the plant are straightline production methods, new modern machine tools, special materials handling equipment, air-recirculating dust control equipment, forced ventilation providing three complete air changes per hour, and many others.

• Arthur H. Navarre, Sales Engineer for the Glass Division of Surface Combustion Corporation, spoke on "Gas Applications in the Glass Industry" at the recent meeting of the American Gas Association in Philadelphia.

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• W. F. Teague has been appointed Sales Manager of the Industrial Product Division of the Gustin-Bacon Manufacturing Company, according to a recent announcement. Mr. Teague will direct sales of the company's Rolagrip and Gruvagrip pipe couplings for the entire United States.

• The Glass Industrial Convention will take place in Freiburg in Breisgau from May 12 to 14, 1953, according to an announcement recently received.

INTEGRA-LEEDS & NORTHUP CONSOLIDATED

The formation of Integra-Leeds & Northrup, Ltd., Birmingham, England, has been jointly announced by Charles S. Redding, President of Leeds & Northrup Company, and Maurice Bouffart, Managing Director of S. A. Integra, Belgium.

The new firm succeeds to the business formerly conducted under the name of The Integra Company, Ltd., which was a branch of the Belgian firm and for some years has been the English agent for Leeds & Northrup products. Ownership of Integra-Leeds & Northrup Ltd. is shared by Leeds & Northrup Company and the owners of the former Integra Company, Ltd.

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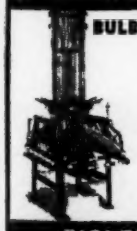

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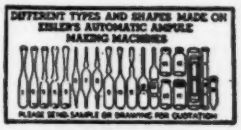

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